Final
Site Inspection Prioritization

International Harvester Landfill
Memphis, Shelby County, Tennessee
EPA ID № TND007024516
WasteLAN № 03631

Prepared Under:
Contract № 68-W9-0055

For The:
U.S. Environmental Protection Agency
Waste Management Division
Region IV

Prepared By:
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BVWS Project № 52012.145

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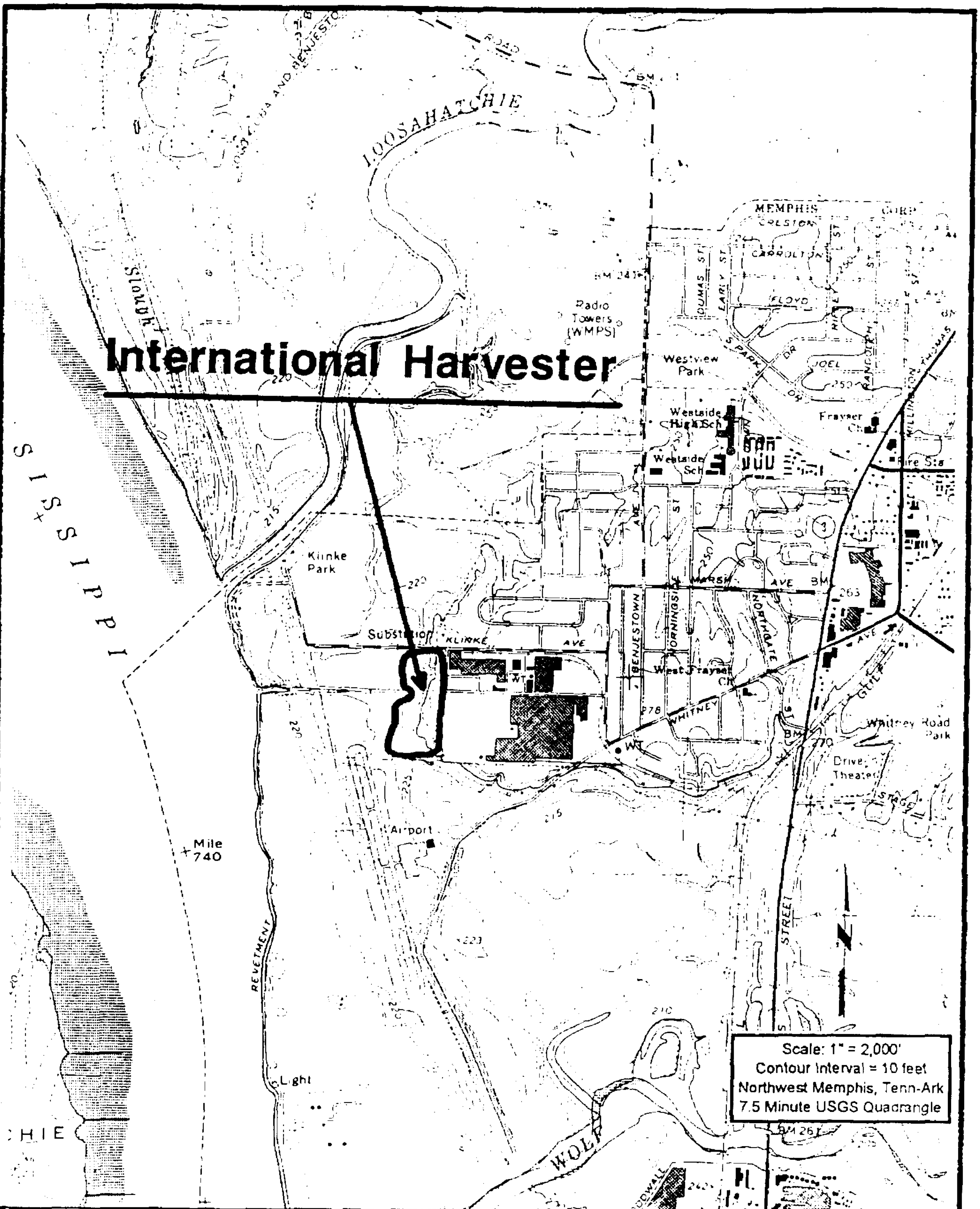
1.0 Introduction

B&V Waste Science and Technology Corp. (BVWST) was tasked by the U.S. Environmental Protection Agency (EPA) to perform a Site Inspection Prioritization (SIP) for the International Harvester Landfill Site in Memphis, Shelby County, Tennessee. This study was performed under the authorization of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendment Reauthorization Act of 1986 (SARA).

A Preliminary Assessment was conducted at the International Harvester Landfill Site by the Tennessee Department of Environment and Conservation, Division of Solid Waste Management (TSWM) for the United States Environmental Protection Agency (USEPA). The Preliminary Assessment was performed in May 1987 1984. A Site Inspection was performed by USEPA in July 1980. An off-site investigation was performed by BVWST on July 27, 1993. Additional sources of information used in this evaluation were EPA CERCLA, TSWM, and Tennessee Division of Superfund file material as well as documentation generated via telephone contacts and letters. Agencies contacted were: the United States Environmental Protection Agency (USEPA) Region IV Atlanta Offices, the Tennessee Department of Environment and Conservation, and local utilities. This SIP will quantify threats posed by the site and provide documentation in order for decisions to be made about a future course of action at the site.

2.0 Site Location, Description, Operational History, and Waste Characteristics

2.1 Location. The International Harvester Landfill Site is located southeast of the confluence of the Loosahatchie and Mississippi Rivers at 3003 Harvester Avenue in Memphis, Tennessee at North latitude 35°08'10.6" and West longitude 89°47'50.4" (Ref. 1). The site location is shown in Figure 1. The climate in this area is characterized by relatively mild winters, hot summers, and abundant rainfall (Ref. 2, p. 2). The average annual precipitation is 50 inches (Ref. 3, p. 1). Mean lake pan evaporation in this area is 41 inches (Ref. 3, p. 2), yielding a net annual rainfall of 9 inches. The 2-year, 24-hour rainfall in the area is approximately 4.0 inches (Ref. 4, p. B-4).



International Harvester Landfill	Figure 1

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Memphis, Shelby County, Tennessee

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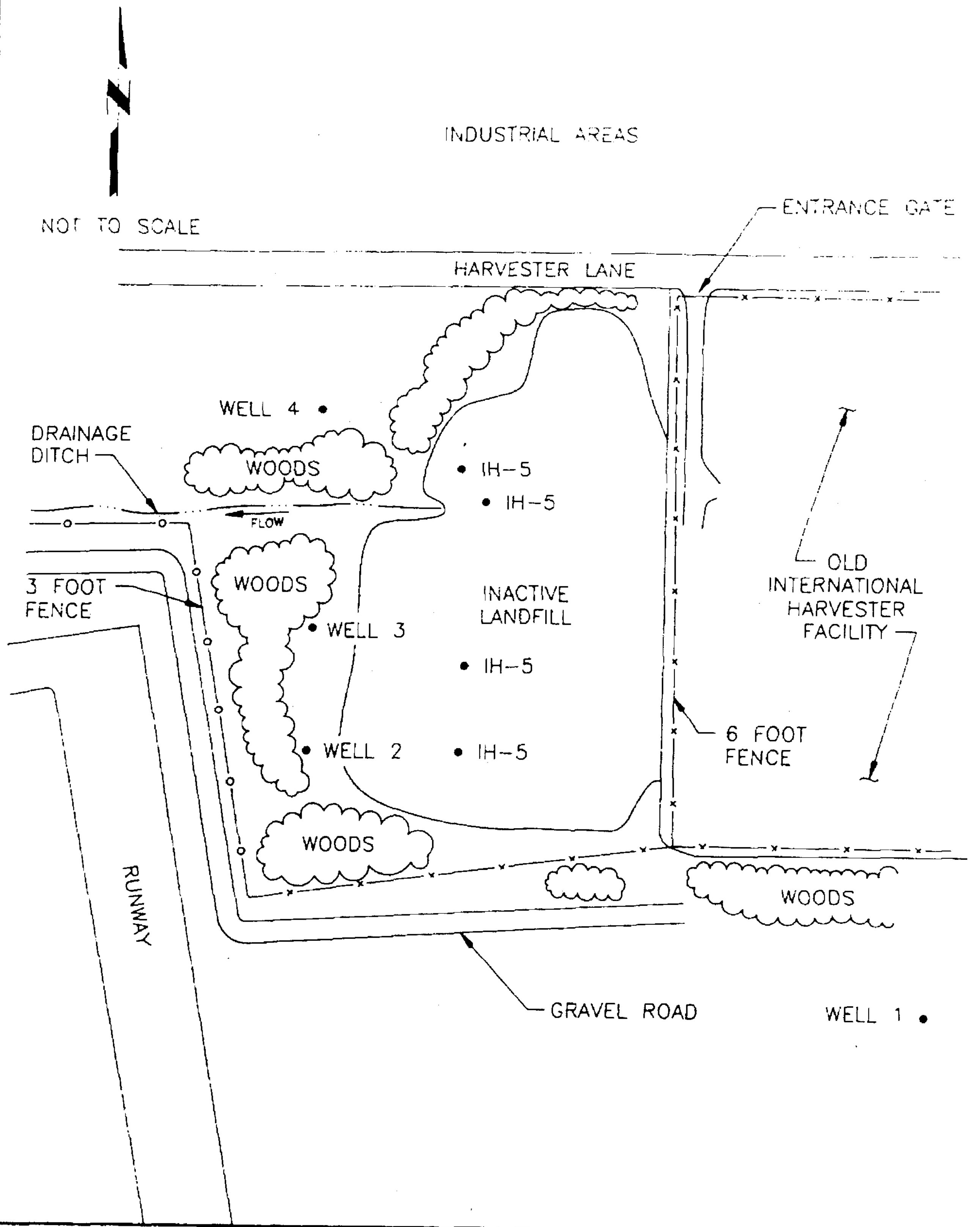
2.2 Site Description. The International Harvester Landfill Site is in an heavily developed industrial area at 3003 Harvester Avenue, Memphis, Tennessee (Ref. 5, 6). The former landfill area is inactive and is covered with grasses and some small shrubs. The landfill areas appears to be mowed and well maintained (Ref. 6). There are lightly wooded areas around the base of the landfill, primarily to the south and west. These forested areas and a gravel road, separate the landfill from the Memphis Shelby County Airport, located adjacent to the west and south (Ref. 6). The landfill is east and adjacent to the former International Harvester plant, now occupied by Mastercraft and Center City Float Factory (Ref. 6). The landfill is bounded to the north by Harvester Lane (Ref. 6). Access to the landfill is unrestricted from the north; however, there is thick vegetation that must be traversed to enter the landfill (Ref. 6). Access from the east and south is restricted by a six-foot high, barbed-wire, chain-link fence (Ref. 6). Access from the west is restricted by a three-foot high, wire fence (Ref. 6).

No stressed vegetation was observed during the August 27, 1993 site investigation (Ref. 6). The landfill occupies an irregular-shaped area a maximum of 650 feet wide and 1,300 feet long (Refs. 5; 6), encompassing approximately 10 acres (Ref. 7). A sketch illustrating the site layout is shown in Figure 2.

2.3 Operational History and Waste Characteristics. The International Harvester Landfill Site is an inactive, closed landfill that was used for the deposition of various industrial wastes by International Harvester Corp. (Ref. 7). International Harvester is no longer operating at the site but had produced farm equipment at the facility since 1947 (Ref. 7). Manufacturing processes included casting, shearing, machining, assembly, washing, plating and painting of farm equipment components (Ref. 8). Wastes from these manufacturing operations were placed into the landfill by International Harvester and included: wood, paper, foundry sand, glass, metal scraps, cardboard, household trash, paint and paint sludge, washing machine sludge, oils, greases, coolants, wastewater treatment sludge, spent transformer oil, varnish, sealing compounds, caustics and acids, electroplating treatment sludge, and other miscellaneous industrial solid wastes (Ref. 8). The landfill was operated from 1947 to November 1983, when landfilling was discontinued (Ref. 8). The landfill is currently covered with a cap of 6 inches of clay and an additional 12 inches of clean soil (Ref. 9). Because of the time when landfilling was started at the site (1947) and the fact that there was no removal of contaminants prior to closure (Ref. 9), we have assumed that there is no liner under the landfill. Closure of the landfill was completed by early 1987, when the maintenance and monitoring program began (Ref. 10). During a Tennessee Division of Superfund inspection performed on June 29, 1989, areas of exposed waste and erosion were observed (Ref. 11). The site is presently being evaluated under monitoring and maintenance program.



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Site Layout Map

Figure 2

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The site was originally discovered during a preliminary inspection by USEPA - Region IV personnel in May of 1980 (Ref. 12, p. 1). Wood, pallets, crates, metal, paper, trash, glass, and drums were observed in the landfill (Ref. 12,, p. 1). On October 20 and 21, 1980, a site investigation was performed at the site by USEPA - Region IV personnel (Ref. 12, p. 1). During this investigation, four sediment, one soil, and two surface water samples were collected and analyzed from the landfill and surrounding areas (Ref. 12, p. 1). The soil sample (IH-5) was a composite of four samples obtained from the top of the landfill (Ref. 12, Figure 2). Locations of these samples is shown in Figure 2. This soil sample indicated the presence of the following compounds in the landfill above naturally occurring levels in soil: **3,4-benzofluoranthene, chromium, copper, nickel, lead, zinc, manganese, cyanide**, and **PCBs** (Refs. 12, Table 2; 13).

The sediment and surface water samples were not accompanied by background samples and therefore, could not be used to determine if there was contamination of the surface water pathway.

On March 14, 1984, the Tennessee Department of Health and Environment issued a commissioners order requiring International Harvester Corp. to prepare a Hazard Assessment and a Remedial Action Plan for closure of the landfill at the site (Ref. 8).

Additional sampling of the landfill and surrounding areas was performed by The Pickering Firm, Inc. on June 15, 1984 on behalf of International Harvester (Ref. 14). This sampling included the collection and analysis of three sediment, two water, and two soil samples. The soil sample "D" was a composite of four samples taken at the same general locations as EPA October 1980 sample number IH-5 (Refs. 12; 14). Locations for these samples are shown in Figure 2. The analytical results for the soil sample were generally similar with the EPA sampling results and did not indicate any additional hazardous source constituents in the landfill (Refs. 12; 14).

The monitoring and maintenance program was initiated in 1987 by International Harvester. As part of this program four groundwater monitoring wells were installed into the surficial aquifer. The depth of these four wells is as follows: Well 1, 41.5 feet; Well 2, 24.8 feet; Well 3, 25.0 feet; and Well 4, 25.0 feet (Ref. 10). Well 1 was used to measure background groundwater conditions because it is at a higher groundwater elevation (Ref. 15). The location of these wells is shown in Figure 2. Tennessee Department of Health and Environment sampled Well 1 and Well 4 on December 4, 1987 (Ref. 16). Analysis of these samples indicated an observed release of nickel, 21 ug/l (12.6 times background); lead, 141 ug/l (4.5 times background); copper, 207 ug/l (23.0 times background), arsenic, 41 ug/l (13.7 times background); cadmium, 13 ug/l (13 times background); zinc, 656 ug/l (32.8 times background); aluminum, 116,240 ug/l (12.2 times background); and barium, 2,129 ug/l (18.5 times background) (Ref. 16). Of these observed releases of hazardous substances, only **nickel**, **lead**, **copper**, and **zinc** can be attributed to the landfill.

Additional analytical data from these wells, obtained during the monitoring and maintenance program, was used to determine if chromium and lead from the landfill had migrated into the groundwater. Chromium and lead were not detected in groundwater above background concentrations in any of the post-closure sampling (Refs. 10, 17, 18, 19).

3.0 Groundwater Pathway

3.1 Hydrogeologic Setting. The International Harvester Landfill Site is situated in the Gulf Coastal Plain Physiographic Province of western Tennessee. The topography of the study area is characterized by loess covered bluffs rising above the Mississippi River Alluvial Plain (Ref. 20, pp. 4-6; Figure 1). The Memphis area is located in the north-central portion of the Mississippi Embayment, a broad structural trough or syncline that plunges south along an axis that parallels the Mississippi River (Ref. 20, p. 6). Formations in the area dip westward towards the embayment and southward on the axis (Ref. 20, p. 6). Topography in the area ranges from 205 feet National Geodetic Vertical Datum (NGVD) to 280 feet NGVD. The International Harvester Landfill Site is located approximately 250 feet NGVD. (Ref. 5).

The major hydrogeologic units found in the Memphis area in descending order are as follows: the loess, alluvium and fluvial deposits that comprise the shallow water-table aquifer, the Jackson, Cockfield and Cook Mountain Formations which together comprise the Jackson-Upper Claibourne confining unit, the Memphis Sand which comprises the Memphis aquifer, the Flour Island Formation and the Fort Pillow Sand (Ref. 20, p. 7).

The soil underlying the facility is classified as Graded land (Gr), Falaya silt loam (Fm) and Memphis silt loam (MeF3) (Ref. 2, Sheet 41). Graded land is characterized by areas where the original soil has been graded for commercial, industrial, and residential development. These materials in these areas are generally silty (Ref. 2, p. 22). Falaya silt loam is characterized by poorly drained, acidic, silt loam soils formed on bottomlands (Ref. 2, p. 16). Memphis silt loam is characterized by well-drained, deep silt loam soils on hillsides (Ref. 2, p. 32). The water table is ranges from 1 foot below land surface (bls) during winter and spring in the Falaya soil to over 6 feet bls in the Memphis sand.. Some areas of the Falaya soil are flooded for short periods in winter and spring (Ref. 2, p. 14).

Alluvial deposits occur both beneath the Mississippi Alluvial Plain and the alluvial plains of the streams which drain the Gulf Coastal Plain and range in thickness from 100 to 150 feet in the Mississippi River Alluvial Plain to less than 50 feet in the alluvial plains of streams in the Gulf Coastal area. The alluvial deposits consist of fine sand, silt, and clay in the upper part and sand and gravel in the lower part (Ref. 20, p. 7). The region was blanketed by a 20 to 50 foot layer of loess during the Pleistocene. Loess consists of wind-blown silt, silty clay, and sand. Recent erosion has thinned or removed the loess deposits along streams. Fluvial deposits underlie alluvium and loess and consist primarily of sand, gravel and minor clay lenses. Locally, the sand and gravel are cemented with iron oxide to form thin layers of sandstone or conglomerate in the basal portions of the unit (Ref. 20, p. 7). The regional range of thickness of these fluvial deposits is 0 to 100 feet depending on the local erosional surface (Ref. 20, p. 6). The total thickness of the alluvial and fluvial deposits in the vicinity of the site is approximately 60 feet (Ref. 20, pp. 13, Table 2).

The Jackson Formation, which consists of fine sand or sandy clay, occurs only beneath the higher hills and ridges in the northern part of the Memphis area (Ref. 20, p. 7). Since the International Harvester Landfill Site is located in the central part of the Memphis area, the Jackson Formation is probably absent beneath the site (Refs. 5; 20). The Cockfield Formation occurs in the subsurface in most of the Memphis area and consists of fine sand, silt, clay and local lenses of lignite. Underlying the Cockfield Formation is the Cook Mountain Formation, which consists primarily of clay (Ref. 20, p. 7). Due to the probable absence of the Jackson Formation, the Cockfield and Cook Mountain formations comprise the Jackson-Upper Claiborne confining unit in the area of the site. The thickness of this confining unit in the vicinity of the International Harvester Landfill Site is approximately 268 feet (Ref. 20, Table 2, Plate 1). Estimated hydraulic conductivity of the Jackson-Upper Claiborne clay unit based on information from Freeze and Cherry (1979) as well as Dr. William S. Parks, ranges from 1×10^{-7} to 1×10^{-5} cm/sec (Refs. 21, p. 29; 22).

The Memphis Sand underlies the Jackson-Upper Claiborne confining unit and is comprised of a thick body of sand that includes subordinate lenses of clay and silt at various horizons (Ref. 20, p. 9). The Memphis Sand ranges in thickness from about 500 to 900 feet. The Memphis Sand is thickest in the southwestern part of the Memphis area and thinnest in the northeastern part (Ref. 20, Table 1). Beneath the site, the Memphis Sand is approximately 800 feet thick (Ref. 20, p. 9 Figure 2, Table 2). In the area of the facility the top of the Memphis Sand occurs approximately 328 feet below land surface (bls) (Ref. 20, Table 2). The potentiometric surface within the Memphis Sand near the International Harvester Landfill Site is approximately 100 feet bls (Ref. 20, Plate 3). This would indicate that the water in the Memphis Sand in the vicinity of the site is under artesian conditions.

According to well logs from the Memphis Defense Depot, the Paleocene-aged Flour Island Formation underlies the Memphis Sand. The top of this formation is located approximately 1,000 to 1,100 feet bls and consists primarily of silty clays and sandy silts. The Flour Island Formation acts as a lower confining unit for the Memphis Sand and an upper confining unit for the Fort Pillow Sand, and it ranges in thickness from 200 to 300 feet (Ref. 20, Figure 2).

The Fort Pillow Sand is the middle sand unit of the Paleocene Wilcox group, and it underlies the Flour Island Formation. This sand ranges from fine sandy textures to coarse sand, and it ranges in thickness from 150 to 300 feet in the Memphis area (Ref. 20, Figure 2)

Groundwater beneath the site is present in the sediments of the loess, alluvium and fluvial deposits, the Memphis Sand aquifer, and in the Fort Pillow Sand. The surficial aquifer consists of the saturated portions of the loess, alluvium and fluvial deposits. The combined thickness of these deposits in the area of the site is approximately 60 feet. The surficial aquifer may be utilized for a few domestic, agricultural, and industrial supplies (Ref. 20, pp. 7). The depth to the water table beneath the site is estimated to be approximately 20 to 35 feet below land surface (bls) (Ref. 10, p. 5).

The Memphis Sand Unit is the primary source of groundwater in the Memphis area. It is confined below by the Flour Island Formation and above by the Jackson Upper Claiborne Confining Unit (Cook Mountain Formation). Recharge to the Memphis Sand aquifer occurs predominantly via percolation of precipitation in outcrop areas 30 to 60 miles east of Memphis. Seepage from the overlying surficial aquifer and the Mississippi River also contribute to the recharge of the Memphis Sand Aquifer (Ref. 23, p. 30). In the last several years, the Memphis Sand has been contaminated due to discontinuity of the Jackson-Upper Claiborne confining unit, heavy pumpage of wellfields in the area, and interconnection of aquifers through drilled wells (Ref. 20, pp. 5-9, 34). Hydraulic conductivities in the Memphis Sand Aquifer are approximately 1×10^{-2} cm/sec (Ref. 21, p. 29).

Underlying the Flour Island Formation is the Fort Pillow Sand. This unit is the second principal aquifer in the Memphis area and supplies about 10 percent of the water there. Hydraulic conductivity for the Fort Pillow Sand is approximated at 1×10^{-2} (Ref. 21, p 29).

The 1990 document <u>Hydrogeology and Preliminary Assessment of the Potential for Contamination of the Memphis Aquifer in the Memphis Area, Tennessee</u> has extensively outlined the Jackson-Upper Claiborne confining unit. The report indicates the presence of the confining unit beneath the site at approximately 60 feet bls with a thickness of 268 feet (Ref. 20, pp. 6-9, Plate 1). Parks (1990) states that the Jackson-Upper Claiborne confining unit is thin, locally absent, and may contain sand "windows" which could provide "pathways" for contaminants to reach the Memphis Sand aquifer. Parks also indicates that downward leakage from the water-table aquifer to the Memphis Sand aquifer is widespread in the Memphis area. Evidence of downward leakage, as discussed by Parks, includes: (Ref. 20, pp. 1, 2, 34-37)

- confining layer absence
- hydraulic head differences between the water table aquifer and the Memphis Sand aquifer
- local water table surface depressions

- long-term declines and reduced seasonal fluctuations in the water table observation wells
- stream water loss based on discharge measurements
- Carbon-14 and tritium concentrations present in the Memphis Sand aquifer indicating "recent" leakage
- water-quality anomalies in the Memphis Sand indicating downward leakage
- volatile organic compounds present in the Memphis Sand aquifer

The presence of organic compounds in the Memphis Sand aquifer indicates that a hydraulic connection between the surficial aquifer and the Memphis Sand aquifer exists. Volatile organic compounds have been detected in Allen wellfield wells (numbers Sh: J-119, Sh: J-120, and Sh J-121) at depths ranging from 398 to 436 feet bls (Ref. 20, p. 35). These wells are located in an area where the confining unit is approximately 68 feet thick The nearest known potential source of contamination in the water table aquifer is 650 feet from the Allen wellfield (Ref. 20, pp. 34-36, Plate 1, Table 6). The migration pathway for the contaminants has not been established. Throughout Memphis the Jackson-Upper Claiborne confining unit is variable in its thickness and lithology. Generally the unit is thick under Memphis and it pinches out to the east; however, in localized zones beneath Memphis, the confining unit is very thin and is potentially absent. The nearest documented location where the confining unit is thin or absent is 9 miles southeast where the unit is absent (Ref. 20, Plate 1).

3.2 Groundwater Targets. There is one Memphis Light, Gas and Water Division (MLGW) wellfield within four miles of the site, the Mallory Station wellfield, located between 3.0 and 4.0 miles south of the site (Ref. 24, p. 11). There are also 18 private wells across the Mississippi River in Arkansas located between 3.0 and 4.0 miles from the site (Ref. 5). In the vicinity of the Mallory wellfield, groundwater in the Memphis Aquifer flows radically toward the pumping wells due to the large cone of depression created by the wellfield (Ref. 20, Plate 1).

The majority of potable water for the residents within four miles of the International Harvester Landfill Site is supplied by MLGW, which operates a blended system serving approximately 565,274 people (Refs. 24; 25; 26). MLGW obtains its water from 162 wells: 143 wells are screened in the Memphis Sand aquifer and 19 wells are screened in the Fort Pillow Sand aquifer (Ref. 24). Thirteen of these municipal wells are located within four miles of International Harvester Landfill Site: 10 of these wells are screened in the Memphis Sand aquifer and 3 wells are screened in the Fort Pillow Sand (Refs. 5; 24). The closest Memphis Sand aquifer well is approximately 3.1 miles southeast of the site (Refs. 5; 24).

Approximately 52 persons located across the Mississippi River in Crittendon County, Arkansas (Ref. 5; 27) obtain water from 18 private wells. These wells have been assumed to be screened in the surficial aquifer because depths to the Memphis sand make it unlikely that private wells utilize it as a drinking water source. The closest alluvial aquifer well is approximately 3.6 miles west of the site (Ref. 5). A more detailed analysis of groundwater targets in the Memphis Sand and Fort Pillow Sand aquifers is provided in Table 1.

TABLE 1
Potable Groundwater Usage within 4 miles of International Harvester Landfill Site

Distance from Site	Wells Counted	Aquifer	Percent of Population Supplied	Apportioned Population	Total Target Population
0-¼ mile	0	n/a[1]	0	0	0
¼-½ mile	0	n/a	0	0	0
½-1 mile	0	n/a	0	0	0
1-2 miles	0	n/a	0	0	0
2-3 miles	0	n/a	0	0	0
3-4 miles	18	Surficial	100%[4]	52[5]	45,413
	10	Memphis Sand	6.17%[2]	34,893[3]	
	3	Fort Pillow Sand	1.85%	10,468	
Total	18	Surficial	100%	52	45,413
	10	Memphis Sand	6.17%	34,893	
	3	Fort Pillow Sand	1.85%	10,468	

[1]Where there are no wells, there are no target aquifers.
[2]The MLGW system has 162 wells. Since no individual well provides more than 40% of the total system production, each well service population is apportioned equally. Each well provides 0.617% of the total production.
[3]Population based on a household average of 2.65 persons/house (Ref. 26).
[4]These private wells provide all drinking water for each residence.
[5]Population based on a household average of 2.89 persons/house (Ref. 27).

4.0 Surface Water Pathway

4.1 Hydrologic Setting. Surface water run-off from approximately 10 acres flows from the International Harvester Landfill and overland to two intermittent ditches: one located west and one located south of the landfill. These ditches each flow west for approximately 1,500 feet where they converge into one intermittent ditch. This intermittent ditch continues to flow west for approximately 800 feet, where it enters the

Mississippi River (Ref 5) This point is the probable point of entry (PPE) for contaminants into the surface water pathway. Flow continues south through the Mississippi River to the termination of the 15-mile surface water pathway, at Mississippi River Mile 725.4, near its confluence with Lake McKellar in Memphis, Tennessee (Ref 5).

The average annual flow rate in the Mississippi River is approximately 580,000 cubic feet per second (cfs) (Ref. 28, p. 2). Portions of the International Harvester Landfill are located within the 100-year floodplain of the Mississippi (Ref. 29).

4.2 Surface Water Targets. There are no surface drinking water intakes along the surface water pathway (Ref. 30). Recreational fishing, swimming, and boating are known to occur on the Mississippi River (Ref. 31). There has been a commercial ban on fishing and recreational fishermen are advised not to eat fish taken from the Mississippi River (Refs. 31, 32). In spite of these advisories, fish are still caught and eaten from the Mississippi River (Ref. 31). Since there is no annual fishing harvest data from these fisheries, the fishery has been assumed to have an average annual yield of greater than one pound.

Forested wetlands are present along the surface water pathway. The closest wetlands are forested located across the Mississippi River, approximately 0.8 miles west of the site. The total in-flow length of wetlands along the surface water pathway is 9.6 miles (Ref 33).

There is one state threatened fish species, blue sucker, (*Cycleptus elongatus*), located approximately 3.3 miles downstream of the site in the Mississippi River (Refs. 5, 34).

5.0 Soil Exposure and Air Pathways

5.1 Physical Conditions. The International Harvester Landfill is inactive and is covered with grasses and some small shrubs. The landfill areas appears to be mowed and well maintained (Ref. 6). There are lightly wooded areas around the base of the landfill, primarily to the south and west. These forested areas and a gravel road, separate the landfill from the Memphis Shelby County Airport, located adjacent to the west and south (Ref. 6). Access to the landfill is unrestricted from the north; however, there is thick vegetation that must be traversed to enter the landfill (Ref. 6). Access from the east and south is restricted by a six-foot high, barbed-wire, chain-link fence (Ref. 6). Access from the west is restricted by a three foot high, wire fence (Ref. 6). No stressed vegetation was observed during the August 27, 1993 site investigation (Ref. 6). The surrounding are is heavily industrialized (Ref. 6).

5.2 Soil and Air Targets. The site is currently inactive and is therefore not subject to contact by workers. There are no schools, residences, or daycare facilities within 200 feet of the site (Ref. 5). The nearest residences are located approximately 0.5 mile east of the site (Ref. 5; 35). The nearest school is the Westside School, located approximately 1 mile northeast of the site (Ref. 5).

There are no known occurrences of threatened or endangered species on the site; however, the Mississippi Kite (*Ictinia mississippiensis*), a state endangered avian species, is located approximately 0.9 mile north of the site (Refs. 5; 34). Approximately 30 acres of forested and emergent wetland are located between ¼ and ½ mile of the site (Ref. 33). Approximately 70 acres of forested, emergent, and scrub-scrub wetland are located between ½ and 1 mile of the site (Ref. 33).

Population in the area within four miles of the site is approximately 60,563 persons, excluding employees, and is detailed as follows: 0 to ¼ mile, 0 persons; ¼ to ½ mile, 0 persons; ½ to 1 mile, 2,599 persons; 1 to 2 miles, 6,128 persons; 2 to 3 miles, 20,234 persons; and 3 to 4 miles, 31,602 persons (Refs. 35).

6.0 Summary and Conclusions

Background information and sample data suggests the presence of 3,4-benzofluoranthene, chromium, copper, nickel, lead, zinc, manganese, cyanide, and PCBs in the landfill at International Harvester. The landfill encompasses approximately 10 acres of area.

The aquifers of concern are the Memphis and Fort Pillow Sands based on the high number of potential drinking water targets approximately 3 to 4 miles southeast of the site. The surficial aquifer provides drinking water to very few residents 3.5 to 4.0 miles west of the site, across the Mississippi River in Arkansas. It is unlikely that contamination in the surficial aquifer would migrate under the Mississippi River because the Mississippi River probably acts as an aquiclude, preventing flow of groundwater to these wells.

Potential contamination of the surface water pathway poses minimal to no threat human health and the environment. There are no drinking water intakes along the pathway, therefore, there is no threat to drinking water targets. While fishing is common along the surface water pathway, high flow rates in the Mississippi River dilute the effect of contamination on fish and sensitive environments in the surface water pathway, minimizing the threat to human food chain and environmental targets.

Potential exposure to contaminated soil and air contamination poses a little threat to humans and the environments within the target distance limits if the site. There are no residents, schools, or day care facilities within 200 feet of the site. Additionally the population nearby is relatively low within 2 miles of the site. Threats to residents beyond this point are minimal due to air dispersal and the low possibility of contact with site contaminants.

Based on the findings of this report, no further investigations are recommended for the International Harvester Landfill Site.

7.0 References

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CONFIDENTIAL
Hazard Ranking System Preliminary Score
for the
International Harvester Landfill
Memphis, Shelby County, Tennessee

The preliminary scores were calculated using the SI worksheets and the HRS Rule of December 1990. Pathways evaluated include air, soil exposure, surface water, and groundwater. The International Harvester Landfill Site is an inactive, closed landfill that was used for the deposition of various industrial wastes by International Harvester Corp. Manufacturing processes included casting, shearing, machining, assembly, washing, plating and painting of farm equipment components. Wastes from these manufacturing operations were placed into the landfill by International Harvester and included: wood, paper, foundry sand, glass, metal scraps, cardboard, household trash, paint and paint sludge, washing machine sludge, oils, greases, coolants, wastewater treatment sludge, spent transformer oil, varnish, sealing compounds, caustics and acids, electroplating treatment sludge, and other miscellaneous industrial solid wastes (Ref. 8). Samples from the landfill indicated the presence of the following compounds: **3,4-benzofluoranthene, chromium, copper, nickel, lead, zinc, manganese, cyanide**, and **PCBs.**

Three scenarios were evaluated during this investigation: Scenario #1, which is BVWST's "best professional judgement" based on the available data; Scenario #2, which is based on an assumed interconnection between the surficial and Memphis Sand aquifers; and Scenario #3, which is based on an assumed observed release of PCBs in a sediment sample taken in the surface water pathway in the Mississippi River fishery.

The closed, capped, landfill encompasses 10 acres. Based on this information and SI Table 1, a hazardous waste quantity score of 100 was calculated for each scenario summarized below.

Scenario #1

This scenario represents BVWST's best professional judgement of how the conditions at the International Harvester Landfill will score under the HRS program based on the available data.

The worksheets indicate the Memphis and Fort Pillow Sand aquifers are the aquifer of concern due primarily to its depth and number of potential targets. While there is an observed release of hazardous contaminants to the surficial aquifer, there are too few targets to outscore the potential targets in the Memphis and Fort Pillow Sand aquifers. The depth to the aquifer of concern is large enough to minimize the potential of release significantly enough to indicate that there is little potential of impacting groundwater targets. The groundwater pathway is the most significant pathway scored and is responsible for most of the overall site score.

The worksheets indicate that there is a moderate potential for a release to surface water. There are no surface water intakes along the pathway; therefore, there is no drinking water threat. There are fisheries and sensitive environments along the pathway but the Mississippi Rivers has an extremely high flow rates that dilutes the impact of hazardous substances on food chain and environmental targets. There is little threat to human food chain resources or sensitive environments.

The worksheets indicate a low likelihood of exposure to hazardous substances at the site to residents because the site is relatively inaccessible. There are no resident targets on or within 200 feet of the site. The nearby population is also relatively low, resulting a low soil exposure score. There is little threat of exposure to hazardous contaminants through soil contact.

The worksheets indicate a low potential of air contamination because there is no population within ½ mile of the site and areas within 4 miles of the site are only moderately populated. While PCBs have a high air mobility/toxicity, the potential effects of contamination are minimized by dispersal factors prior to reaching populated areas and sensitive environments.

This scenario indicates the overall site score is low and does not indicate the need to further investigate this site under the HRS process.

Scenario #2

Documentation gathered in the SIP investigation indicates the possibility that there is an interconnection between the overlying surficial aquifer and the Memphis Sand aquifer, although the same documentation indicates that the nearest interconnection is 9 miles to the southeast. This scenario is identical to Scenario #1, except BVWST examined the effect that aquifer interconnection would have on the site score.

This scenario results in a higher groundwater pathway and overall site score than Scenario #1 because of the addition of the MLGW drinking water targets to the observed release; however, the overall site score remains low and does not indicate the need to further investigate this site under the HRS process.

Scenario #3

Sediment and water sampling in the 1980 EPA Site Investigation indicated PCB contamination in the drainage ditch from the landfill. This data could not be used because there were no background samples and the samples were not on the surface water pathway (the ditches are intermittent). However, we feel that there is a possibility that a sediment sample, taken at the mouth of the ditch in the Mississippi could indicate a PCB "hit". Since the Mississippi is a fishery, this sample would allow the human food chain targets to be scored as Level II targets.

This scenario increases the surface water pathway score by one order of magnitude; however, it not significantly affect the overall site score. This scenario does not indicate the need to further investigate this site under the HRS process.

Conclusions

Scenarios #1, #2, and #3 indicate that the site will not score over the HRS threshold of 28.5 based on the current data available. Based on this information, no further action is recommended for the International Harvester Landfill Site.

Pathway	Scenario #1	Scenario #2	Scenario #3
Groundwater	4.57	27.93	4.57
Surface Water	0.037	0.037	96.065
Soil Exposure	0.01	0.01	0.01
Air	3.44	3.44	3.44
Overall Score	**2.86**	**14.07**	**48.12**

HRS Scoresheets
Scenario #1

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

GROUNDWATER MIGRATION PATHWAY SCORESHEET

Likelihood of Release to an Aquifer	Maximum Value	Aquifer 1 Assigned Value	Aquifer 2 Assigned Value	Aquifer 3 Assigned Value
1. Observed Release	550	550	0	0
2. Potential to Release				
2a. Containment	10	10	10	10
2b. Net Precipitation	10	3	3	3
2c. Depth to Aquifer	5	5	1	1
2d. Travel Time	35	25	5	5
2e. Potential to Release (lines 2a x (2b+2c+2d)	500	330	90	90
3. Likelihood of Release (higher of lines 1 and 2e.)	550	**550**	**90**	**90**
Waste Characteristics				
4. Toxicity/Mobility	a	100	100	100
5. Hazardous Waste Quantity	a	100	100	100
6. Waste Characteristics	100	**10**	**10**	**10**
Targets				
7. Nearest Well	50	2	2	2
8. Population				
8a. Level I Concentrations	b	0	0	0
8b. Level II Concentrations	b	0	0	0
8c. Potential Contamination	b	0.4	417	417
8d. Population (lines 8a+8b+8c)	b	0.4	417	417
9. Resources	5	0	0	0
10. Wellhead Protection Area	20	0	0	0
11. Targets (lines 7+8d+9+10)	b	**2.4**	**419**	**419**
Groundwater Migration Score for an Aquifer				
12. Aquifer Score [(lines 3 x 6 x 11)/82,500]	100	**0.16**	**4.57**	**4.57**
Groundwater Migration Pathway Score				
13. Pathway Score (Sgw) – Highest value for all aquifers evaluated	100		$\boxed{4.57}$	

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

DRINKING WATER THREAT

	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
Likelihood of Release			
1. Observed Release	550	0	n a
2. Potential Release by Overland Flow			
2a. Containment	10	9	
2b. Runoff	25	1	
2c. Distance to Surface Water	25	6	
2d. Potential to Release by Overland Flow lines 2a x (2b + 2c)	500	63	0
3. Potential to Release by Flood			
3a. Containment	10	10	
3b. Flood Frequency	50	25	
3c. Potential to Release by Flood (Lines 3a x 3b)	500	250	0
4. Potential to Release (lines 2d + 3c)	500	313	0
5. Likelihood of Release (Higher of lines 1 and 4)	550	313	0
Waste Characteristics			
6. Toxicity/Persistence	a	10000	
7. Hazardous Waste Quantity	a	100	
8. Waste Characteristics	100	32	
Targets			
9. Nearest Intake	50	0	
10. Population			
10a. Level I Concentrations	b	0	
10b. Level II Concentrations	b	0	
10c. Potential Contamination	b	0	
10d. Population (lines 10a+10b+10c)	b	0	0
11. Resources	5	0	
12. Targets (lines 9+10d+11)	b	0	0
Drinking Water Threat Score			
13. Drinking Water Threat Score [(lines 5 x 8 x 12)/82500)]	100	0.00	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET
(continued)

HUMAN FOOD CHAIN THREAT

	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
Likelihood of Release			
14. Likelihood of Release (Same as line 5)	550	313	0
Waste Characteristics			
15. Toxicity/Persistence/Bioaccumulation	a	500000000	
16. Hazardous Waste Quantity	a	100	
17. Waste Characteristics	1000	320	
Targets			
18. Food Chain Individual	50	0	
19. Population			
19a. Level I Concentrations	b	0	
19b. Level II Concentrations	b	0	
19c. Potential Human Food Chain Contamination	b	0.03	
19d. Population (lines 19a+19b+19c)	b	0.03	0
20. Targets (lines 18+19d)	b	0.03	0
Human Food Chain Threat Score			
21. Human Food Chain Threat Score [(lines 14 x 17 x 20)/82500)]	100	0.0364	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET
(continued)

ENVIRONMENTAL THREAT

Likelihood of Release	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
22. Likelihood of Release (Same as line 5)	550	313	0
Waste Characteristics			
23. Ecosystem Toxicity/Persistence/Bioaccumulation	a	500000000	
24. Hazardous Waste Quantity	a	100	
25. Waste Characteristics	1000	320	
Targets			
26. Sensitive Environments			
26a. Level I Concentrations	b	0	
26b. Level II Concentrations	b	0	
26c. Potential Environmental Contamination	b	0.0003	
26d. Population (lines 26a+26b+26c)	b	0.0003	0
27. Targets (value on lines 26d)	b	0.0003	0
Environmental Threat Score			
28. Environmental Threat Score [(lines 22 x 25 x 27)/82500)]	60	0.00036	0

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE – WATERSHED

29. Watershed Score (Lines 13 +21+28)	100	0.037	0

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE – WATERSHED

30. Watershed Score (Highest of all watersheds)	100	$\boxed{0.0368}$

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SOIL EXPOSURE PATHWAY SCORESHEET

RESIDENT POPULATION THREAT

	Maximum Value	Assigned Value
Likelihood of Exposure		
1. Likelihood of Exposure	550	550
Waste Characteristics		
2. Toxicity	a	10000
3. Hazardous Waste Quantity	a	100
4. Waste Characteristics	100	32
Targets		
5. Resident Indivudual	50	0
6. Resident Population		
6a. Level I Concentrations	b	0
6b. Level II Concentrations	b	0
6c. Resident Population (lines 6a+6b)	b	0
7. Workers	15	0
8. Resources	5	0
9. Terrestrial Sensitive Environments	c	0
10. Targets (lines 5+6c+7+8+9)	b	0
Resident Population Threat Score		
11. Resident Population Threat [(lines 1 x 4 x 10)/82500)]	b	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c No specific maximum value applies to factor. However, pathway score based solely on sensitive environments [illegible] max. 60

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SOIL EXPOSURE PATHWAY SCORESHEET
(continued)

NEARBY POPULATION THREAT

	Maximum Value	Assigned Value
Likelihood of Exposure		
12. Attractiveness/Accessibility	100	5
13. Area of Contamination	100	50
14. Liklihood of Exposure	500	25
Waste Characteristics		
15. Toxicity	a	10000
16. Hazardous Waste Quantity	a	100
17. Waste Characteristics	100	32
Targets		
18. Nearby Indivudual	1	0
19. Population Within One Mile	b	1
20. Targets (lines 18+19)	b	1
Nearby Population Threat Score		
21. Nearby Population Threat [(lines 14 x 47 x 20)/82500)]	b	0.01

SOIL EXPOSURE PATHWAY SCORE

	Maximum Value	Assigned Value
22. Soil Exposure Pathway Score (Ss) (Lines 11 + 21)	100	$\boxed{0.01}$

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c No specific maximum value applies to factor. However, pathway score based solely on sensitive environments is limited [illegible]

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

AIR MIGRATION PATHWAY SCORESHEET

	Maximum Value	Assigned Value
Likelihood of Release		
1. Observed Release	550	
2. Potential to Release		
2a. Gas Potential to Release	500	500
2b. Particulate Potential to Release	500	500
2e. Potential to Release (Higher of lines 2a and 2b)	500	500
3. Likelihood of Release (higher of lines 1 and 2e.)	a	500
Waste Characteristics		
4. Toxicity/Mobility	a	20000
5. Hazardous Waste Quantity	a	100
6. Waste Characteristics	100	32
Targets		
7. Nearest Individual	50	1
8. Population		
8a. Level I Concentrations	b	0
8b. Level II Concentrations	b	0
8c. Potential Contamination	b	16.4
8d. Population (lines 8a+8b+8c)	b	16.4
9. Resources	5	0
10. Sensitive Environments		
10a. Actual Contamination	c	0
10b. Potential Contamination	c	0
10c. Sensitive Environments (lines 10a+10b)	c	0.335
11. Targets (lines 7+8d+9+10c)	b	17.74
Groundwater Migration Pathway Score		
12. Pathway Score (Sa) [(lines 3 x 6 x 11)/82500]	100	$\boxed{3.44}$

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c No specific maximum value applies to factor. However, pathway score based [illegible]

HRS Scoresheets
Scenario #1

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SITE SCORING SUMMARY

Groundwater Migration Pathway Score	4.57
Surface Water Migration Pathway Score	0.037
Soil Exposure Migration Pathway Score	0.01
Air Migration Pathway Score	3.44
Overall Site Score	2.86

HRS Scoresheets
Scenario #2

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

GROUNDWATER MIGRATION PATHWAY SCORESHEET

Likelihood of Release to an Aquifer	Maximum Value	Aquifer 1 Assigned Value	Aquifer 2 Assigned Value	Aquifer 3 Assigned Value
1. Observed Release	550	550	0	n/a
2. Potential to Release				
2a. Containment	10	10	10	0
2b. Net Precipitation	10	3	3	0
2c. Depth to Aquifer	5	5	1	0
2d. Travel Time	35	25	5	0
2e. Potential to Release (lines 2a x (2b+2c+2d)	500	330	90	0
3. Likelihood of Release (higher of lines 1 and 2e.)	550	550	90	0
Waste Characteristics				
4. Toxicity/Mobility	a	100	100	0
5. Hazardous Waste Quantity	a	100	100	0
6. Waste Characteristics	100	10	10	0
Targets				
7. Nearest Well	50	2	2	0
8. Population				
8a. Level I Concentrations	b	0	0	0
8b. Level II Concentrations	b	0	0	0
8c. Potential Contamination	b	417	417	0
8d. Population (lines 8a+8b+8c)	b	417	417	0
9. Resources	5	0	0	0
10. Wellhead Protection Area	20	0	0	0
11. Targets (lines 7+8d+9+10)	b	419	419	0
Groundwater Migration Score for an Aquifer				
12. Aquifer Score [(lines 3 x 6 x 11)/82,500]	100	27.93	4.57	0.00
Groundwater Migration Pathway Score				
13. Pathway Score (Sgw) – Highest value for all aquifers evaluated	100		27.93	

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND FLOOD MIGRATION COMPONENT SCORESHEET

DRINKING WATER THREAT

Likelihood of Release	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
1. Observed Release	550	0	n.a
2. Potential Release by Overland Flow			
2a. Containment	10	9	
2b. Runoff	25	1	
2c. Distance to Surface Water	25	6	
2d. Potential to Release by Overland Flow lines 2a x (2b + 2c)	500	63	0
3. Potential to Release by Flood			
3a. Containment	10	10	
3b. Flood Frequency	50	25	
3c. Potential to Release by Flood (Lines 3a x 3b)	500	250	0
4. Potential to Release (lines 2d + 3c)	500	313	0
5. Likelihood of Release (Higher of lines 1 and 4)	550	**313**	0
Waste Characteristics			
6. Toxicity/Persistence	a	10000	
7. Hazardous Waste Quantity	a	100	
8. Waste Characteristics	100	**32**	
Targets			
9. Nearest Intake	50	0	
10. Population			
10a. Level I Concentrations	b	0	
10b. Level II Concentrations	b	0	
10c. Potential Contamination	b	0	
10d. Population (lines 10a+10b+10c)	b	0	0
11. Resources	5	0	
12. Targets (lines 9+10d+11)	b	**0**	0
Drinking Water Threat Score			
13. Drinking Water Threat Score [(lines 5 x 8 x 12)/82500)]	100	**0.00**	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET
(continued)

HUMAN FOOD CHAIN THREAT

Likelihood of Release	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
14. Likelihood of Release (Same as line 5)	550	313	0
Waste Characteristics			
15. Toxicity/Persistence/Bioaccumulation	a	500000000	
16. Hazardous Waste Quantity	a	100	
17. Waste Characteristics	1000	320	
Targets			
18. Food Chain Individual	50	0	
19. Population			
19a. Level I Concentrations	b	0	
19b. Level II Concentrations	b	0	
19c. Potential Human Food Chain Contamination	b	0.03	
19d. Population (lines 19a+19b+19c)	b	0.03	0
20. Targets (lines 18+19d)	b	0.03	0
Human Food Chain Threat Score			
21. Human Food Chain Threat Score [(lines 14 x 17 x 20)/82500)]	100	0.0364	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET
(continued)

ENVIRONMENTAL THREAT

Likelihood of Release	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
22. Likelihood of Release (Same as line 5)	550	313	0
Waste Characteristics			
23. Ecosystem Toxicity/Persistence/Bioaccumulation	a	500000000	
24. Hazardous Waste Quantity	a	100	
25. Waste Characteristics	1000	320	
Targets			
26. Sensitive Environments			
26a. Level I Concentrations	b	0	
26b. Level II Concentrations	b	0	
26c. Potential Environmental Contamination	b	0.0003	
26d. Population (lines 26a+26b+26c)	b	0.0003	0
27. Targets (value on lines 26d)	b	0.0003	0
Environmental Threat Score			
28. Environmental Threat Score [(lines 22 x 25 x 27)/82500)]	60	0.00036	0

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE – WATERSHED

	Maximum Value	Watershed 1	Watershed 2
29. Watershed Score (Lines 13 +21+28)	100	0.037	0

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE – WATERSHED

	Maximum Value	Score
30. Watershed Score (Highest of all watersheds)	100	$\boxed{0.0368}$

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SOIL EXPOSURE PATHWAY SCORESHEET

RESIDENT POPULATION THREAT

Likelihood of Exposure	Maximum Value	Assigned Value
1. Likelihood of Exposure	550	550
Waste Characteristics		
2. Toxicity	a	10000
3. Hazardous Waste Quantity	a	10
4. Waste Characteristics	100	32
Targets		
5. Resident Individual	50	0
6. Resident Population		
6a. Level I Concentrations	b	0
6b. Level II Concentrations	b	0
6c. Resident Population (lines 6a+6b)	b	0
7. Workers	15	0
8. Resources	5	0
9. Terrestrial Sensitive Environments	c	0
10. Targets (lines 5+6c+7+8+9)	b	0
Resident Population Threat Score		
11. Resident Population Threat [(lines 1 x 4 x 10)/82500)]	b	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c No specific maximum value applies to factor. However, pathway score based solely on sensitive environments [illegible]

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SOIL EXPOSURE PATHWAY SCORESHEET
(continued)

NEARBY POPULATION THREAT

	Maximum Value	Assigned Value
Likelihood of Exposure		
12. Attractiveness/Accessibility	100	5
13. Area of Contamination	100	50
14. Liklihood of Exposure	500	25
Waste Characteristics		
15. Toxicity	a	10000
16. Hazardous Waste Quantity	a	100
17. Waste Characteristics	100	32
Targets		
18. Nearby Indivudual	1	0
19. Population Within One Mile	b	1
20. Targets (lines 18+19)	b	1
Nearby Population Threat Score		
21. Nearby Population Threat [(lines 14 x 47 x 20)/82500)]	b	0.01

SOIL EXPOSURE PATHWAY SCORE

	Maximum Value	Assigned Value
22. Soil Exposure Pathway Score (Ss) (Lines 11 + 21)	100	$\boxed{0.01}$

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c No specific maximum value applies to factor. However, pathway score based solely on sensitive [illegible]

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

AIR MIGRATION PATHWAY SCORESHEET

	Maximum Value	Assigned Value
Likelihood of Release		
1. Observed Release	550	0
2. Potential to Release		
2a. Gas Potential to Release	500	500
2b. Particulate Potential to Release	500	500
2e. Potential to Release (Higher of lines 2a and 2b)	500	500
3. Likelihood of Release (higher of lines 1 and 2e.)	a	500
Waste Characteristics		
4. Toxicity/Mobility	a	10000
5. Hazardous Waste Quantity	a	100
6. Waste Characteristics	100	32
Targets		
7. Nearest Individual	50	1
8. Population		
8a. Level I Concentrations	b	0
8b. Level II Concentrations	b	0
8c. Potential Contamination	b	16.4
8d. Population (lines 8a+8b+8c)	b	16.4
9. Resources	5	0
10. Sensitive Environments		
10a. Actual Contamination	c	0
10b. Potential Contamination	c	0
10c. Sensitive Environments (lines 10a+10b)	c	0.335
11. Targets (lines 7+8d+9+10c)	b	17.74
Groundwater Migration Pathway Score		
12. Pathway Score (Sa) [(lines 3 x 6 x 11)/82500]	100	3.44

a Maximum value applies to waste characteristics category

b Maximum value not applicable

c No specific maximum value applies to factor. However, pathway score based solely on sensitive environments is limited [illegible]

HRS Scoresheets
Scenario #2

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SITE SCORING SUMMARY

Groundwater Migration Pathway Score	27.93
Surface Water Migration Pathway Score	0.037
Soil Exposure Migration Pathway Score	0.01
Air Migration Pathway Score	3.44
Overall Site Score	14.07

HRS Scoresheets
Scenario #3

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

GROUNDWATER MIGRATION PATHWAY SCORESHEET

Likelihood of Release to an Aquifer	Maximum Value	Aquifer 1 Assigned Value	Aquifer 2 Assigned Value	Aquifer 3 Assigned Value
1. Observed Release	550	550	0	0
2. Potential to Release				
2a. Containment	10	10	10	10
2b. Net Precipitation	10	3	3	3
2c. Depth to Aquifer	5	5	1	1
2d. Travel Time	35	25	5	5
2e. Potential to Release (lines 2a x (2b+2c+2d)	500	330	90	90
3. Likelihood of Release (higher of lines 1 and 2e.)	550	**550**	**90**	**90**
Waste Characteristics				
4. Toxicity/Mobility	a	100	100	100
5. Hazardous Waste Quantity	a	100	100	100
6. Waste Characteristics	100	**10**	**10**	**10**
Targets				
7. Nearest Well	50	2	2	2
8. Population				
8a. Level I Concentrations	b	0	0	0
8b. Level II Concentrations	b	0	0	0
8c. Potential Contamination	b	0.4	417	417
8d. Population (lines 8a+8b+8c)	b	0.4	417	417
9. Resources	5	0	0	0
10. Wellhead Protection Area	20	0	0	0
11. Targets (lines 7+8d+9+10)	b	**2.4**	**419**	**419**
Groundwater Migration Score for an Aquifer				
12. Aquifer Score [(lines 3 x 6 x 11)/82,500]	100	0.16	4.57	4.57
Groundwater Migration Pathway Score				
13. Pathway Score (Sgw) – Highest value for all aquifers evaluated	100		$\boxed{4.57}$	

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET

DRINKING WATER THREAT

Likelihood of Release	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
1. Observed Release	550	550	n/a
2. Potential Release by Overland Flow			
2a. Containment	10	0	
2b. Runoff	25	1	
2c. Distance to Surface Water	25	0	
2d. Potential to Release by Overland Flow lines 2a x (2b + 2c)	500	63	0
3. Potential to Release by Flood			
3a. Containment	10	10	
3b. Flood Frequency	50	25	
3c. Potential to Release by Flood (Lines 3a x 3b)	500	250	0
4. Potential to Release (lines 2d + 3c)	500	313	0
5. Likelihood of Release (Higher of lines 1 and 4)	550	550	0
Waste Characteristics			
6. Toxicity/Persistence	a	10000	
7. Hazardous Waste Quantity	a	100	
8. Waste Characteristics	100	32	
Targets			
9. Nearest Intake	50	0	
10. Population			
10a. Level I Concentrations	b	0	
10b. Level II Concentrations	b	0	
10c. Potential Contamination	b	0	
10d. Population (lines 10a+10b+10c)	b	0	0
11. Resources	5	0	
12. Targets (lines 9+10d+11)	b	0	0
Drinking Water Threat Score			
13. Drinking Water Threat Score [(lines 5 x 8 x 12)/82500)]	100	0.00	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET (continued)

HUMAN FOOD CHAIN THREAT

Likelihood of Release	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
14. Likelihood of Release (Same as line 5)	550	550	0
Waste Characteristics			
15. Toxicity/Persistence/Bioaccumulation	a	500000000	
16. Hazardous Waste Quantity	a	100	
17. Waste Characteristics	1000	320	
Targets			
18. Food Chain Individual	50	45	
19. Population			
19a. Level I Concentrations	b	0	
19b. Level II Concentrations	b	0	
19c. Potential Human Food Chain Contamination	b	0.03	
19d. Population (lines 19a+19b+19c)	b	0.03	0
20. Targets (lines 18+19d)	b	45.03	0
Human Food Chain Threat Score			
21. Human Food Chain Threat Score [(lines 14 x 17 x 20)/82500)]	100	96.0640	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORESHEET
(continued)

ENVIRONMENTAL THREAT

Likelihood of Release	Maximum Value	Watershed 1 Assigned Value	Watershed 2 Assigned Value
22. Likelihood of Release (Same as line 5)	550	550	0
Waste Characteristics			
23. Ecosystem Toxicity/Persistence/Bioaccumulation	a	500000000	
24. Hazardous Waste Quantity	a	100	
25. Waste Characteristics	1000	320	
Targets			
26. Sensitive Environments			
26a. Level I Concentrations	b	0	
26b. Level II Concentrations	b	0	
26c. Potential Environmental Contamination	b	0.0003	
26d. Population (lines 26a+26b+26c)	b	0.0003	0
27. Targets (value on lines 26d)	b	0.0003	0
Environmental Threat Score			
28. Environmental Threat Score [(lines 22 x 25 x 27)/82500)]	60	0.00064	0

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE – WATERSHED

29. Watershed Score (Lines 13 +21+28)	100	96.065	0

SURFACE WATER OVERLAND/FLOOD MIGRATION COMPONENT SCORE – WATERSHED

30. Watershed Score (Highest of all watersheds)	100	$\boxed{96.0646}$

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c Do not round to nearest integer

Site Name: International Harvester Landfill
Location: Memphis Tennessee

SOIL EXPOSURE PATHWAY SCORESHEET

RESIDENT POPULATION THREAT

	Maximum Value	Assigned Value
Likelihood of Exposure		
1. Likelihood of Exposure	550	550
Waste Characteristics		
2. Toxicity	a	10000
3. Hazardous Waste Quantity	a	100
4. Waste Characteristics	100	32
Targets		
5. Resident Individual	50	0
6. Resident Population		
6a. Level I Concentrations	b	0
6b. Level II Concentrations	b	0
6c. Resident Population (lines 6a+6b)	b	0
7. Workers	15	0
8. Resources	5	0
9. Terrestrial Sensitive Environments	c	0
10. Targets (lines 5+6c+7+8+9)	b	0
Resident Population Threat Score		
11. Resident Population Threat [(lines 1 x 4 x 10)/82500)]	b	0

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c No specific maximum value applies to factor. However, pathway score based solely on sensitive environments is limited to maximum of 60.

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SOIL EXPOSURE PATHWAY SCORESHEET
(continued)

NEARBY POPULATION THREAT

	Maximum Value	Assigned Value
<u>Likelihood of Exposure</u>		
12. Attractiveness/Accessibility	200	5
13. Area of Contamination	100	50
14. Liklihood of Exposure	500	25
<u>Waste Characteristics</u>		
15. Toxicity	a	10000
16. Hazardous Waste Quantity	a	100
17. Waste Characteristics	100	32
<u>Targets</u>		
18. Nearby Indivudual	1	0
19. Population Within One Mile	b	1
20. Targets (lines 18+19)	b	1
<u>Nearby Population Threat Score</u>		
21. Nearby Population Threat [(lines 14 x 47 x 20)/82500)]	b	0.01

SOIL EXPOSURE PATHWAY SCORE

	Maximum Value	Assigned Value
22. Soil Exposure Pathway Score (Ss) (Lines 11 + 21)	100	$\boxed{0.01}$

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c No specific maximum value applies to factor. However, pathway score based solely on sensitive environments is limited [illegible]

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

AIR MIGRATION PATHWAY SCORESHEET

Likelihood of Release	Maximum Value	Assigned Value
1. Observed Release	550	
2. Potential to Release		
2a. Gas Potential to Release	500	500
2b. Particulate Potential to Release	500	500
2c. Potential to Release (Higher of lines 2a and 2b)	500	500
3. Likelihood of Release (higher of lines 1 and 2c.)	a	500
Waste Characteristics		
4. Toxicity/Mobility	a	10000
5. Hazardous Waste Quantity	a	100
6. Waste Characteristics	100	32
Targets		
7. Nearest Individual	50	1
8. Population		
8a. Level I Concentrations	b	0
8b. Level II Concentrations	b	0
8c. Potential Contamination	b	16.4
8d. Population (lines 8a+8b+8c)	b	16.4
9. Resources	5	0
10. Sensitive Environments		
10a. Actual Contamination	c	0
10b. Potential Contamination	c	0
10c. Sensitive Environments (lines 10a+10b)	c	0.335
11. Targets (lines 7+8d+9+10c)	b	17.74
Groundwater Migration Pathway Score		
12. Pathway Score (Sa) [(lines 3 x 6 x 11)/82500]	100	**3.44**

a Maximum value applies to waste characteristics category
b Maximum value not applicable
c No specific maximum value applies to factor. However, pathway score based solely on sens[illegible]

HRS Scoresheets
Scenario #3

Site Name: *International Harvester Landfill*
Location: *Memphis, Tennessee*

SITE SCORING SUMMARY

Groundwater Migration Pathway Score	4.57
Surface Water Migration Pathway Score	96.065
Soil Exposure Migration Pathway Score	0.01
Air Migration Pathway Score	3.44
Overall Site Score	48.12

APPENDIX C

SITE INSPECTION WORKSHEETS

This appendix consists of worksheets that can be used to generate an SI site score. Completion of these worksheets is not required, but the SI investigator must evaluate an SI score, either by these worksheets, *PREscore*, or other Regional scoring tools.

The worksheets consist of instructions and data tables to be filled in with scores from HRS reference tables. The data tables may also call for Data Type and References.

DATA TYPE: The Data Type columns should be filled in with an **H**, **Q**, or **+** if the data are HRS quality and well documented. The Data Type column should be filled in with an **E**, **X**, or **-** if the data represent estimates, approximations, or are not fully documented. This type identifies data gaps for the expanded SI to investigate.

REFERENCES: The Reference columns should be filled in with coded reference numbers. The numbered reference list should be attached or the numbering should be cross-referenced to the SI Narrative Report.

The SI investigator will need the current Superfund Chemical Data Matrix (SCDM) OSWER Directive 9345.1-13 (revised semi-annually) to complete these worksheets.

SITE INSPECTION WORKSHEETS

CERCLIS IDENTIFICATION NUMBER

SITE LOCATION			
SITE NAME: LEGAL, COMMON, OR DESCRIPTIVE NAME OF SITE			
STREET ADDRESS, ROUTE, OR SPECIFIC LOCATION IDENTIFIER			
CITY	STATE	ZIP CODE	TELEPHONE ( )
COORDINATES: LATITUDE and LONGITUDE	TOWNSHIP, RANGE, AND SECTION		

OWNER/OPERATOR IDENTIFICATION					
OWNER			OPERATOR		
OWNER ADDRESS			OPERATOR ADDRESS		
CITY			CITY		
STATE	ZIP CODE	TELEPHONE ( )	STATE	ZIP CODE	TELEPHONE ( )

SITE EVALUATION		
AGENCY/ORGANIZATION		
INVESTIGATOR		
CONTACT		
ADDRESS		
CITY	STATE	ZIP CODE
TELEPHONE ( )		

GENERAL INFORMATION

Site Description and Operational History: Provide a brief description of the site and its operational history. State the site name, owner, operator, type of facility and operations, size of property, active or inactive status, and years of waste generation. Summarize waste treatment, storage, or disposal activities that have or may have occurred at the site; note whether these activities are documented or alleged. Identify all source types and prior spills, floods, or fires. Summarize highlights of the PA and other investigations. Cite references.

GENERAL INFORMATION (continued)

Site Sketch: Provide a sketch of the site. Indicate all pertinent features of the site and nearby environments including sources of wastes, areas of visible and buried wastes, buildings, residences, access roads, parking areas, fences, fields, drainage patterns, water bodies, vegetation, wells, sensitive environments, and other features.

GENERAL INFORMATION (continued)

Source Descriptions: Describe all sources at the site. Identify source type and relate to waste disposal operations. Provide source dimensions and the best available waste quantity information. Describe the condition of sources and all containment structures. Cite references.

SOURCE TYPES

Landfill: A man-made (by excavation or construction) or natural hole in the ground into which wastes have come to be disposed by backfilling, or by contemporaneous soil deposition with waste disposal.

Surface Impoundment: A natural topographic depression, man-made excavation, or diked area primarily formed from earthen materials (lined or unlined) and designed to hold an accumulation of liquid wastes, wastes containing free liquids, or sludges not backfilled or otherwise covered; depression may be wet with exposed liquid or dry if deposited liquid has evaporated, volatilized or leached; structures that may be described as lagoon, pond, aeration pit, settling pond, tailings pond, sludge pit; also a surface impoundment that has been covered with soil after the final deposition of waste materials (i.e., buried or backfilled).

Drum: A portable container designed to hold a standard 55-gallon volume of wastes.

Tank and Non-Drum Container: Any device, other than a drum, designed to contain an accumulation of waste that provides structural support and is constructed primarily of fabricated materials (such as wood, concrete, steel, or plastic); any portable or mobile device in which waste is stored or otherwise handled.

Contaminated Soil: An area or volume of soil onto which hazardous substances have been spilled, spread, disposed, or deposited.

Pile: Any non-containerized accumulation above the ground surface of solid, non-flowing wastes; includes open dumps. Some types of waste piles are:

- Chemical Waste Pile: A pile consisting primarily of discarded chemical products, by-products, radioactive wastes, or used or unused feedstocks.
- Scrap Metal or Junk Pile: A pile consisting primarily of scrap metal or discarded durable goods (such as appliances, automobiles, auto parts, batteries, etc.) composed of materials containing hazardous substances.
- Tailings Pile: A pile consisting primarily of any combination of overburden from a mining operation and tailings from a mineral mining, beneficiation, or processing operation.
- Trash Pile: A pile consisting primarily of paper, garbage, or discarded non-durable goods containing hazardous substances.

Land Treatment: Landfarming or other method of waste management in which liquid wastes or sludges are spread over land and tilled, or liquids are injected at shallow depths into soils.

Other: Sources not in categories listed above.

GENERAL INFORMATION (continued)

Source Description: Include description of containment per pathway for ground water (see HRS Table 3-2), surface water (see HRS Table 4-2), and air (see HRS Tables 6-3 and 6-9).

Hazardous Waste Quantity (HWQ) Calculation: SI Tables 1 and 2 (See HRS Tables 2-5, 2-6, and 5-2).

Attach additional pages, if necessary

HWQ =

SI TABLE 1: HAZARDOUS WASTE QUANTITY (HWQ) SCORES FOR SINGLE SOURCE SITES AND FORMULAS FOR MULTIPLE SOURCE SITES

		Single Source Sites (assigned HWQ scores)	
(Column 1) TIER	(Column 2) Source Type	(Column 3) HWQ = 10	(Column 4) HWQ = 100
A Hazardous Constituent Quantity	N/A	HWQ = 1 if Hazardous Constituent Quantity data are complete HWQ = 10 if Hazardous Constituent Quantity data are not complete	>100 to 10,000 lbs
B Hazardous Wastestream Quantity	N/A	≤ 500,000 lbs	>500,000 to 50 million lbs
C Volume	Landfill	≤ 6.75 million ft^3 ≤ 250,000 yd^3	>6.75 million to 675 million ft^3 >250,000 to 25 million yd^3
	Surface impoundment	≤6,750 ft^3 ≤250 yd^3	>6,750 to 675,000 ft^3 >250 to 25,000 yd^3
	Drums	≤1,000 drums	>1,000 to 100,000 drums
	Tanks and non-drum containers	≤50,000 gallons	>50,000 to 5 million gallons
	Contaminated soil	≤6.75 million ft^3 ≤250,000 yd^3	>6.75 million to 675 million ft^3 >250,000 to 25 million yd^3
	Pile	≤6,750 ft^3 ≤250 yd^3	>6,750 to 675,000 ft^3 >250 to 25,000 yd^3
	Other	≤6,750 ft^3 ≤250 yd^3	>6,750 to 675,000 ft^3 >250 to 25,000 yd^3
D Area	Landfill	≤340,000 ft^2 ≤7.8 acres	>340,000 to 34 million ft^2 >7.8 to 780 acres
	Surface impoundment	≤1,300 ft^2 ≤0.029 acres	>1,300 to 130,000 ft^2 >0.029 to 2.9 acres
	Contaminated soil	≤3.4 million ft^2 ≤78 acres	> 3.4 million to 340 million ft^2 > 78 to 7,800 acres
	Pile	≤1,300 ft^2 ≤0.029 acres	>1,300 to 130,000 ft^2 >0.029 to 2.9 acres
	Land treatment	≤27,000 ft^2 ≤0.62 acres	>27,000 to 2.7 million ft^2 >0.62 to 62 acres

TABLE 1 (CONTINUED)

Single Source Sites (assigned HWQ scores)		Multiple Source Sites		
(Column 5) HWQ = 10,000	(Column 6) HWQ = 1,000,000	(Column 7) Divisors for Assigning Source WQ Values	(Column 2) Source Type	(Column 1) TIER
>10,000 to 1 million lbs	> 1 million lbs	lbs ÷ 1	N/A	**A** Hazardous Constituent Quantity
>50 million to 5 billion lbs	> 5 billion lbs	lbs ÷ 5,000	N/A	**B** Hazardous Wastestream Quantity
>675 million to 67.5 billion ft^3 >25 million to 2.5 billion yd^3	> 67.5 billion ft^3 > 2.5 billion yd^3	ft^3 ÷ 67,500 yd^3 ÷ 2,500	Landfill	**C** Volume
>675,000 to 67.5 million ft^3 >25,000 to 2.5 million yd^3	> 67.5 million ft^3 > 2.5 million yd^3	ft^3 ÷ 67.5 yd^3 ÷ 2.5	Surface Impoundment	
>100,000 to 10 million drums	> 10 million drums	drums ÷ 10	Drums	
>5 million to 500 million gallons	> 500 million gallons	gallons ÷ 500	Tanks and non-drum containers	
>675 million to 67.5 billion ft^3 >25 million to 2.5 billion yd^3	> 67.5 billion ft^3 > 2.5 billion yd^3	ft^3 ÷ 67,500 yd^3 ÷ 2,500	Contaminated Soil	
>675,000 to 67.5 million ft^3 >25,000 to 2.5 million yd^3	> 67.5 million ft^3 > 2.5 million yd^3	ft^3 ÷ 67.5 yd^3 ÷ 2.5	Pile	
>675,000 to 67.5 million ft^3 >25,000 to 2.5 million yd^3	> 67.5 million ft^3 > 2.5 million yd^3	ft^3 ÷ 67.5 yd^3 ÷ 2.5	Other	
>34 million to 3.4 billion ft^2 >780 to 78,000 acres	> 3.4 billion ft^2 >78,000 acres	ft^2 ÷ 3,400 acres ÷ 0.078	Landfill	**D** Area
>130,000 to 13 million ft^2 >2.9 to 290 acres	> 13 million ft^2 > 290 acres	ft^2 ÷ 13 acres ÷ 0.00029	Surface Impoundment	
> 340 million to 34 billion ft^2 > 7,800 to 780,000 acres	> 34 billion ft^2 > 780,000 acres	ft^2 ÷ 34,000 acres ÷ 0.78	Contaminated Soil	
> 130,000 to 13 million ft^2 > 2.9 to 290 acres	> 13 million ft^2 > 290 acres	ft^2 ÷ 13 acres ÷ 0.00029	Pile	
>2.7 million to 270 million ft^2 >62 to 6,200 acres	> 270 million ft^2 > 6,200 acres	ft^2 ÷ 270 acres ÷ 0.0062	Land Treatment	

HAZARDOUS WASTE QUANTITY (HWQ) CALCULATION

For each migration pathway, evaluate HWQ associated with sources that are available (i.e., incompletely contained) to migrate to that pathway. (Note: If *Actual Contamination Targets* exist for ground water, surface water, or air migration pathways, assign the calculated HWQ score or 100, whichever is greater, as the HWQ score for that pathway.) For each source, evaluate HWQ for one or more of the four tiers (SI Table 1; HRS Table 2-5) for which data exist: constituent quantity, wastestream quantity, source volume, and source area. Select the tier that gives the highest value as the source HWQ. Select the source volume HWQ rather than source area HWQ if data for both tiers are available.

Column 1 of SI Table 1 indicates the quantity tier. Column 2 lists source types for the four tiers. Columns 3, 4, 5, and 6 provide ranges of waste amount for sites with only one source, corresponding to HWQ scores at the tops of the columns. Column 7 provides formulas to obtain source waste quantity values at sites with multiple sources.

1. Identify each source type.
2. Examine all waste quantity data available for each source. Record constituent quantity and waste stream mass or volume. Record dimensions of each source.
3. Convert source measurements to appropriate units for each tier to be evaluated.
4. For each source, use the formulas in the last column of SI Table 1 to determine the waste quantity value for each tier that can be evaluated. Use the waste quantity value obtained from the highest tier as the quantity value for the source.
5. Sum the values assigned to each source to determine the total site waste quantity.
6. Assign HWQ score from SI Table 2 (HRS Table 2-6).

Note these exceptions to evaluate soil exposure pathway HWQ (see HRS Table 5-2):

- The divisor for the area (square feet) of a landfill is 34,000.
- The divisor for the area (square feet) of a pile is 34.
- Wet surface impoundments and tanks and non-drum containers are the only sources for which volume measurements are evaluated for the soil exposure pathway.

SI TABLE 2: HWQ SCORES FOR SITES

Site WQ Total	HWQ Score
0	0
1[a] to 100	1[b]
> 100 to 10,000	100
> 10,000 to 1 million	10,000
> 1 million	1,000,000

[a] If the WQ total is between 0 and 1, round it to 1.
[b] If the hazardous constituent quantity data are not complete, assign the score of 10.

SI TABLE 3: WASTE CHARACTERIZATION WORKSHEET

Site Name: [illegible]

References ______________________________

Sources:

1. [illegible] 4. ____________ 7. ____________
2. ____________ 5. ____________ 8. ____________
3. ____________ 6. ____________ 9. ____________

SOURCE	HAZARDOUS SUBSTANCE	TOXICITY	GROUND WATER PATHWAY		SURFACE WATER PATHWAY										
					OVERLAND/FLOOD MIGRATION							GROUND WATER TO SURFACE WATER			
			x GW Mobility (HRS Table 3-8)	Tox/ Mobility Value (HRS Table 3-9)	x Per (HRS Tables 4-10 and 4-11)	Tox/Per Value (HRS Table 4-12)	x Bioac Pot. (HRS Table 4-15)	Tox/ Pers/ Bioac Value (HRS Table 4-16)	x Ecotox (HRS Table 4-19)	Ecotox/ Pers (HRS Table 4-20)	Ecotox/ Pers/ Bioacc Value (HRS Table 4-21)	Tox/ Mob/ Pers Value (HRS Table 4-26)	Tox/ Mob/ Pers/ Bioacc Value (HRS Table 4-28)	Ecotox/ Mob/ Pers Value (HRS Table 4-29)	Ecotox/ Mob/ Pers/ Bioacc Value (HRS Table 4-30)
	[illegible]	[illegible]	[illegible]	1	1	[illegible]	[illegible]	[illegible]	–		–				
	[illegible]	[illegible]	[illegible]		1	[illegible]	[illegible]	[illegible]	[illegible]						
	[illegible]	–	[illegible]	–	1	[illegible]	[illegible]		100		[illegible]				
	[illegible]	[illegible]	[illegible]		1	[illegible]	[illegible]		10		[illegible]				
	[illegible]	[illegible]	[illegible]		1	[illegible]	50	[illegible]	[illegible]		[illegible]				
	[illegible]	1	[illegible]			[illegible]		[illegible]			[illegible]				
	[illegible]	[illegible]	[illegible]		1		[illegible]	[illegible]	–		–				
1	[illegible]	100	–	–	0.4		5	–	100						
1	[illegible]	[illegible]	10^{-4}	1	1		[illegible]	[illegible]	[illegible]						
	→							[illegible]							

Ground Water Observed Release Substances Summary Table

On SI Table 4, list the hazardous substances associated with the site detected in ground water samples for that aquifer. Include only those substances directly observed or with concentrations significantly greater than background levels. Obtain toxicity values from the Superfund Chemical Data Matrix (SCDM). Assign mobility a value of 1 for all observed release substances regardless of the aquifer being evaluated. For each substance, multiply the toxicity by the mobility to obtain the toxicity/mobility factor value; enter the highest toxicity/mobility value for the aquifer in the space provided.

Ground Water Actual Contamination Targets Summary Table

If there is an observed release at a drinking water well, enter each hazardous substance meeting the requirements for an observed release by well and sample ID on SI Table 5 and record the detected concentration. Obtain benchmark, cancer risk, and reference dose concentrations from SCDM. For MCL and MCLG benchmarks, determine the highest percentage of benchmark obtained for any substance. For cancer risk and reference dose, sum the percentages for the substances listed. If benchmark, cancer risk, or reference dose concentrations are not available for a particular substance, enter N/A for the percentage. If the highest benchmark percentage or the percentage sum calculated for cancer risk or reference dose equals or exceeds 100%, evaluate the population using the well as a Level I target. If these percentages are less than 100% or all are N/A, evaluate the population using the well as a Level II target for that aquifer.

SI TABLE 4: GROUND WATER OBSERVED RELEASE SUBSTANCES (BY AQUIFER)

Sample ID	Hazardous Substance	Bckgrd. Conc.	Toxicity/ Mobility	References
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
		Highest Toxicity/Mobility	[illegible]	

SI TABLE 5: GROUND WATER ACTUAL CONTAMINATION TARGETS

Well ID: ______ Level I ______ Level II ______ Population Served ______ References ______

Sample ID	Hazardous Substance	Conc. (µg/L)	Benchmark Conc. (MCL or MCLG)	% of Benchmark	Cancer Risk Conc.	% of Cancer Risk Conc.	RfD	% of RfD
			Highest Percent		Sum of Percents		Sum of Percents	

Well ID: ______ Level I ______ Level II ______ Population Served ______ References ______

Sample ID	Hazardous Substance	Conc. (µg/L)	Benchmark Conc. (MCL or MCLG)	% of Benchmark	Cancer Risk Conc.	% of Cancer Risk Conc.	RfD	% of RfD
			Highest Percent		Sum of Percents		Sum of Percents	

GROUND WATER PATHWAY
GROUND WATER USE DESCRIPTION

Describe Ground Water Use within 4 Miles of the Site:
Describe generalized stratigraphy, aquifers, municipal and private wells

Show Calculations of Ground Water Drinking Water Populations for each Aquifer:
Provide apportionment calculations for blended supply systems.
County average number of persons per household: 2.65 Reference [illegible]

GROUND WATER PATHWAY WORKSHEET

LIKELIHOOD OF RELEASE	Score	Data Type	Refs
1. OBSERVED RELEASE: If sampling data or direct observation support a release to the aquifer, assign a score of 550. Record observed release substances on SI Table 4			
2. POTENTIAL TO RELEASE: Depth to aquifer: _______ feet. If sampling data do not support a release to the aquifer, and the site is in karst terrain or the depth to aquifer is 70 feet or less, assign a score of 500; otherwise, assign a score of 340. Optionally, evaluate potential to release according to HRS Section 3.			
LR =			

TARGETS			
Are any wells part of a blended system? Yes____ No_____ If yes, attach a page to show apportionment calculations. 3. ACTUAL CONTAMINATION TARGETS: If analytical evidence indicates that any target drinking water well for the aquifer has been exposed to a hazardous substance from the site, evaluate the factor score for the number of people served (SI Table 5). Level I: _______ people x 10 = _______ Level II: _______ people x 1 = _______ Total =			
4. POTENTIAL CONTAMINATION TARGETS: Determine the number of people served by drinking water wells for the aquifer or overlying aquifers that are not exposed to a hazardous substance from the site; record the population for each distance category in SI Table 6a or 6b. Sum the population values and multiply by 0.1.			
5. NEAREST WELL: Assign a score of 50 for any Level I Actual Contamination Targets for the aquifer or overlying aquifer. Assign a score of 45 if there are Level II targets but no Level I targets. If no Actual Contamination Targets exist, assign the Nearest Well score from SI Table 6a or 6b. If no drinking water wells exist within 4 miles, assign 0.			
6. WELLHEAD PROTECTION AREA (WHPA): If any source lies within or above a WHPA for the aquifer, or if a ground water observed release has occurred within a WHPA, assign a score of 20; assign 5 if neither condition applies but a WHPA is within 4 miles; otherwise assign 0.			
7. RESOURCES: Assign a score of 5 if one or more ground water resource applies; assign 0 if none applies. • Irrigation (5 acre minimum) of commercial food crops or commercial forage crops • Watering of commercial livestock • Ingredient in commercial food preparation • Supply for commercial aquaculture • Supply for a major or designated water recreation area, excluding drinking water use			
Sum of Targets T=			

SI TABLE 6 (From HRS TABLE 3-12): VALUES FOR POTENTIAL CONTAMINATION GROUND WATER TARGET POPULATIONS

SI Table 6a: Other Than Karst Aquifers

Distance from Site	Pop.	Nearest Well (choose highest)	Population Served by Wells within Distance Category: 1 to 10	11 to 30	31 to 100	101 to 300	301 to 1000	1001 to 3000	3001 to 10,000	10,001 to 30,000	30,001 to 100,000	100,001 to 300,000	300,001 to 1,000,000	1,000,000 to 3,000,000	Pop. Value	Ref.
0 to $\frac{1}{4}$ mile		20	4	17	53	164	522	1,633	5,214	16,325	52,137	163,246	521,360	1,632,455		
> $\frac{1}{4}$ to $\frac{1}{2}$ mile		18	2	11	33	102	324	1,013	3,233	10,122	32,325	101,213	323,243	1,012,122		
> $\frac{1}{2}$ to 1 mile		9	1	5	17	52	167	523	1,669	5,224	16,684	52,239	166,835	522,385		
> 1 to 2 miles		5	0.7	3	10	30	94	294	939	2,939	9,385	29,384	93,845	293,842		
> 2 to 3 miles		3	0.5	2	7	21	68	212	678	2,122	6,778	21,222	67,777	212,219		
>3 to 4 miles		2	0.3	1	4	13	42	131	417	1,306	4,171	13,060	41,709	130,596	4	

Nearest Well = 2

Sum = 4

SI TABLE 6 (From HRS TABLE 3-12): VALUES FOR POTENTIAL CONTAMINATION GROUND WATER TARGET POPULATIONS (continued)

SI Table 6b: Karst Aquifers

Distance from Site	Pop.	Nearest Well (choose highest)	Population Served by Wells within Distance Category: 1 to 10	11 to 30	31 to 100	101 to 300	301 to 1000	1001 to 3000	3001 to 10,000	10,001 to 30,000	30,001 to 100,000	100,001 to 300,000	300,001 to 1,000,000	1,000,000 to 3,000,000	Pop. Value	Ref.
0 to $\frac{1}{4}$ mile		20	4	17	53	164	522	1,633	5,214	16,325	52,137	163,246	521,360	1,632,455		
> $\frac{1}{4}$ to $\frac{1}{2}$ mile		20	2	11	33	102	324	1,013	3,233	10,122	32,325	101,213	323,243	1,012,122		
> $\frac{1}{2}$ to 1 mile		20	2	9	26	82	261	817	2,607	8,163	26,068	81,623	260,680	816,227		
> 1 to 2 miles		20	2	9	26	82	261	817	2,607	8,163	26,068	81,623	260,680	816,227		
> 2 to 3 miles		20	2	9	26	82	261	817	2,607	8,163	26,068	81,623	260,680	816,227		
>3 to 4 miles		20	2	9	26	82	261	817	2,607	8,163	26,068	81,623	260,680	816,227		

Nearest Well =

Sum =

GROUND WATER PATHWAY WORKSHEET (concluded)

WASTE CHARACTERISTICS	Score	Data Type	Does not Apply
8. If any Actual Contamination Targets exist for the aquifer or overlying aquifers, assign the calculated hazardous waste quantity score or a score of 100, whichever is greater; if no Actual Contamination Targets exist, assign the hazardous waste quantity score calculated for sources available to migrate to ground water.	100 100 100		
9. Assign the highest ground water toxicity/mobility value from SI Table 3 or 4.	100 100 100		
10. Multiply the ground water toxicity/mobility and hazardous waste quantity scores. Assign the Waste Characteristics score from the table below: (from HRS Table 2-7)			

Product	WC Score
0	0
>0 to <10	1
10 to <100	2
100 to <1,000	3
1,000 to < 10,000	6
10,000 to <1E + 05	10
1E + 05 to <1E + 06	18
1E + 06 to <1E + 07	32
1E + 07 to <1E + 08	56
1E + 08 or greater	100

WC =

Multiply LR by T and by WC. Divide the product by 82,500 to obtain the ground water pathway score for each aquifer. Select the highest aquifer score. If the pathway score is greater than 100, assign 100.

GROUND WATER PATHWAY SCORE: $\frac{LR \times T \times WC}{82,500}$

(Maximum of 100)

SURFACE WATER PATHWAY

Sketch of the Surface Water Migration Route:
Label all surface water bodies. Include runoff route and drainage direction probable point of entry, and 15-mile target distance limit. Mark sample locations, intakes, fisheries, and sensitive environments. Indicate flow directions, tidal influence, and rate.

SURFACE WATER PATHWAY

Surface Water Observed Release Substances Summary Table

On SI Table 7, list the hazardous substances detected in surface water samples for the watershed which can be attributed to the site. Include only those substances in observed releases (direct observation) or with concentration levels significantly above background levels. Obtain toxicity, persistence, bioaccumulation potential, and ecotoxicity values from SCDM. Enter the highest toxicity/persistence, toxicity/persistence/bioaccumulation, and ecotoxicity/persistence/ecobioaccumulation values in the spaces provided.

- TP = Toxicity x Persistence
- TPB = TP x bioaccumulation
- ETPB = EP x bioaccumulation (EP = ecotoxicity x persistence)

Drinking Water Actual Contamination Targets Summary Table

For an observed release at or beyond a drinking water intake, on SI Table 8 enter each hazardous substance by sample ID and the detected concentration. For surface water sediment samples detecting a hazardous substance at or beyond an intake, evaluate the intake as Level II contamination. Obtain benchmark, cancer risk, and reference dose concentrations for each substance from SCDM. For MCL and MCLG benchmarks, determine the highest percentage of benchmark obtained for any substance. For cancer risk and reference dose, sum the percentages of the substances listed. If benchmark, cancer risk, or reference dose concentrations are not available for a particular substance, enter N/A for the percentage. If the highest benchmark percentage or the percentage sum calculated for cancer risk or reference dose equals or exceeds 100%, evaluate the population served by the intake as a Level I target. If the percentages are less than 100% or all are N/A, evaluate the population served by the intake as a Level II target.

SI TABLE 7: SURFACE WATER OBSERVED RELEASE SUBSTANCES

Sample ID	Hazardous Substance	Bckgrd. Conc.	Toxicity/ Persistence	Toxicity/ Persis./ Bioaccum	Ecotoxicity/ Persis/ Ecobioaccum	References
		Highest Values				

SI TABLE 8: SURFACE WATER DRINKING WATER ACTUAL CONTAMINATION TARGETS

Intake ID: ____________ Sample Type ____________________ Level I ______ Level II _____ Population Served _______ References ________

Sample ID	Hazardous Substance	Conc. (µg/L)	Benchmark Conc. (MCL or MCLG)	% of Benchmark	Cancer Risk Conc.	% of Cancer Risk Conc.	RfD	% of RfD
			Highest Percent		Sum of Percents		Sum of Percents	

Intake ID: ____________ Sample Type ____________________ Level I ______ Level II _____ Population Served _______ References ________

Sample ID	Hazardous Substance	Conc. (µg/L)	Benchmark Conc. (MCL or MCLG)	% of Benchmark	Cancer Risk Conc.	% of Cancer Risk Conc.	RfD	% of RfD
			Highest Percent		Sum of Percents		Sum of Percents	

SURFACE WATER PATHWAY

LIKELIHOOD OF RELEASE AND DRINKING WATER THREAT WORKSHEET

LIKELIHOOD OF RELEASE– OVERLAND/FLOOD MIGRATION	Score	Data Type	Refs
1. OBSERVED RELEASE: If sampling data or direct observation support a release to surface water in the watershed, assign a score of 550. Record observed release substances on SI Table 7.			
2. POTENTIAL TO RELEASE: Distance to surface water: ____(feet) If sampling data do not support a release to surface water in the watershed, use the table below to assign a score from the table below based on distance to surface water and flood frequency.			

Distance to surface water <2500 feet	500
Distance to surface water >2500 feet, and:.	
Site in annual or 10-yr floodplain	500
Site in 100-yr floodplain	400
Site in 500-yr floodplain	300
Site outside 500-yr floodplain	100

Optionally, evaluate surface water potential to release according to HRS Section 4.1.2.1.2

LR =

LIKELIHOOD OF RELEASE GROUND WATER TO SURFACE WATER MIGRATION	Score	Data Type	Refs
1. OBSERVED RELEASE: If sampling data or direct observation support a release to surface water in the watershed, assign a score of 550. Record observed release substances on SI Table 7. NOTE: Evaluate ground water to surface water migration only for a surface water body that meets all of the following conditions: 1) A portion of the surface water is within 1 mile of site sources having a containment factor greater than 0. 2) No aquifer discontinuity is established between the source and the above portion of the surface water body. 3) The top of the uppermost aquifer is at or above the bottom of the surface water. Elevation of top of uppermost aquifer ________ Elevation of bottom of surface water body ________			
2. POTENTIAL TO RELEASE: Use the ground water potential to release. Optionally, evaluate surface water potential to release according to HRS Section 3.1.2.			

LR =

250

SURFACE WATER PATHWAY
LIKELIHOOD OF RELEASE AND DRINKING WATER THREAT WORKSHEET (CONTINUED)

DRINKING WATER THREAT TARGETS	Score	Data Type	Refs
Record the water body type, flow, and number of people served by each drinking water intake within the target distance limit in the watershed. If there is no drinking water intake within the target distance limit, assign 0 to factors 3, 4, and 5. Intake Name | Water Body Type | Flow | People Served ____ | ____ | ____ | ____ ____ | ____ | ____ | ____ ____ | ____ | ____ | ____ Are any intakes part of a blended system? Yes ______ No _✓__ If yes, attach a page to show apportionment calculations. 3. ACTUAL CONTAMINATION TARGETS: If analytical evidence indicates a drinking water intake has been exposed to a hazardous substance from the site, list the intake name and evaluate the factor score for the drinking water population (SI Table 8). ________________ , ________________ Level I: _____ people x 10 = ________ Level II: _____ people x 1 = ________ **Total =**	0		
4. POTENTIAL CONTAMINATION TARGETS: Determine the number of people served by drinking water intakes for the watershed that have not been exposed to a hazardous substance from the site. Assign the population values from SI Table 9. Sum the values and multiply by 0.1.			
5. NEAREST INTAKE: Assign a score of 50 for any Level I Actual Contamination Drinking Water Targets for the watershed. Assign a score of 45 if there are Level II targets for the watershed, but no Level I targets. If no Actual Contamination Drinking Water Targets exist, assign a score for the Intake nearest the PPE from SI Table 9. If no drinking water intakes exist, assign 0.			
6. RESOURCES: Assign a score of 5 if one or more surface water resource applies; assign 0 if none applies. • Irrigation (5 acre minimum) of commercial food crops or commercial forage crops • Watering of commercial livestock • Ingredient in commercial food preparation • Major or designated water recreation area, excluding drinking water use			

SUM OF TARGETS T= 0

SI TABLE 9 (From HRS Table 4-14): DILUTION-WEIGHTED POPULATION VALUES FOR POTENTIAL CONTAMINATION FOR SURFACE WATER MIGRATION PATHWAY

Type of Surface Water Body	Pop.	Nearest Intake	Number of people: 0	1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	Pop. Value
Minimal Stream (<10 cfs)		20	0	4	17	53	164	522	1,633	5,214	16,325	
Small to moderate stream (10 to 100 cfs)		2	0	0.4	2	5	16	52	163	521	1,633	
Moderate to large stream (> 100 to 1,000 cfs)		0	0	0.04	0.2	0.5	2	5	16	52	163	
Large Stream to river (>1,000 to 10,000 cfs)		0	0	0.004	0.02	0.05	0.2	0.5	2	5	16	
Large River (> 10,000 to 100,000 cfs)		0	0	0	0.002	0.005	0.02	0.05	0.2	0.5	16	
Very Large River (>100,000 cfs)		0	0	0	0	0.001	0.002	0.005	0.02	0.05	0.2	
Shallow ocean zone or Great Lake (depth < 20 feet)		0	0	0	0.002	0.005	0.02	0.05	0.2	0.5	2	
Moderate ocean zone or Great Lake (Depth 20 to 200 feet)		0	0	0	0	0.001	0.002	0.005	0.02	0.05	0.2	
Deep ocean zone or Great Lake (depth > 200 feet)		0	0	0	0	0	0.001	0.003	0.008	0.03	0.08	
3-mile mixing zone in quiet flowing river (≥ 10 cfs)		10	0	2	9	26	82	261	817	2,607	8,163	

Nearest Intake = ______

Sum = ______

References ______________________

SURFACE WATER PATHWAY

Human Food Chain Actual Contamination Targets Summary Table

On SI Table 10, list the hazardous substances detected in sediment, aqueous, sessile benthic organism tissue, or fish tissue samples (taken from fish caught within the boundaries of the observed release) by sample ID and concentration. Evaluate fisheries within the boundaries of observed releases detected by sediment or aqueous samples as Level II, if at least one observed release substance has a bioaccumulation potential factor value of 500 or greater (see SI Table 7). Obtain benchmark, cancer risk, and reference dose concentrations from SCDM. For FDAAL benchmarks, determine the highest percentage of benchmark obtained for any substance. For cancer risk and reference dose, sum the percentages for the substances listed. If benchmark, cancer risk, or reference dose concentrations are not available for a particular substance, enter N/A for the percentage. If the highest benchmark percentage sum calculated for cancer risk or reference dose equals or exceeds 100%, evaluate this portion of the fishery as subject to Level I concentrations. If the percentages are less than 100% or all are N/A, evaluate the fishery as a Level II target.

Sensitive Environment Actual Contamination Targets Summary Table

On SI Table 11, list each hazardous substance detected in aqueous or sediment samples at or beyond wetlands or a surface water sensitive environment by sample ID. Record the concentration. If contaminated sediments or tissues are detected at or beyond a sensitive environment, evaluate the sensitive environment as Level II. Obtain benchmark concentrations from SCDM. For AWQC/AALAC benchmarks, determine the highest percentage of benchmark of the substances detected in aqueous samples. If benchmark concentrations are not available for a particular substance, enter N/A for the percentage. If the highest benchmark percentage equals or exceeds 100%, evaluate that part of the sensitive environment subject to Level I concentrations. If the percentage is less than 100%, or all are N/A, evaluate the sensitive environment as Level II.

SI TABLE 10: HUMAN FOOD CHAIN ACTUAL CONTAMINATION TARGETS FOR WATERSHED

Fishery ID: ______ Sample Type ______ Level I ______ Level II ✓ References ______

Sample ID	Hazardous Substance	Conc. (mg/kg)	Benchmark Concentration (FDAAL)	% of Benchmark	Cancer Risk Concentration.	% of Cancer Risk Concentration	RfD	% of RfD
[illegible]	[illegible]	1,300						
			Highest Percent		Sum of Percents		Sum of Percents	

SI TABLE 11: SENSITIVE ENVIRONMENT ACTUAL CONTAMINATION TARGETS FOR WATERSHED

Environment ID: ______ Sample Type ______ Level I ______ Level II ______ Environment Value ______

Sample ID	Hazardous Substance	Conc.. (µg/L)	Benchmark Concentration (AWQC or AALAC)	% of Benchmark	References
			Highest Percent		

Environment ID: ______ Sample Type ______ Level I ______ Level II ______ Environment Value ______

Sample ID	Hazardous Substance	Conc.. (µg/L)	Benchmark Concentration (AWQC or AALAC)	% of Benchmark	References
			Highest Percent		

SURFACE WATER PATHWAY (continued)
HUMAN FOOD CHAIN THREAT WORKSHEET

HUMAN FOOD CHAIN THREAT TARGETS	Score	Data Type	Refs
Record the water body type and flow for each fishery within the target distance limit. If there is no fishery within the target distance limit, assign a score of 0 at the bottom of this page.			
Fishery Name [illegible] Water Body [illegible] Flow [illegible] cfs			
Species [illegible] Production [illegible] lbs/yr			
Species ______ Production ______ lbs/yr			
Fishery Name ______ Water Body ______ Flow ______ cfs			
Species ______ Production ______ lbs/yr			
Species ______ Production ______ lbs/yr			
Fishery Name ______ Water Body ______ Flow ______ cfs	0.03		
Species ______ Production ______ lbs/yr			
Species ______ Production ______ lbs/yr			

FOOD CHAIN INDIVIDUAL

7. ACTUAL CONTAMINATION FISHERIES:

If analytical evidence indicates that a fishery has been exposed to a hazardous substance with a bioaccumulation factor greater than or equal to 500 (SI Table 10), assign a score of 50 if there is a Level I fishery. Assign 45 if there is a Level II fishery, but no Level I fishery.

8. POTENTIAL CONTAMINATION FISHERIES:

If there is a release of a substance with a bioaccumulation factor greater than or equal to 500 to a watershed containing fisheries within the target distance limit, but there are no Level I or Level II fisheries, assign a score of 20.

If there is no observed release to the watershed, assign a value for potential contamination fisheries from the table below using the lowest flow at all fisheries within the target distance limit:

Lowest Flow	FCI Value
<10 cfs	20
10 to 100 cfs	2
>100 cfs, coastal tidal waters, oceans, or Great Lakes	0
3-mile mixing zone in quiet flowing river	10

FCI Value = 0

SUM OF TARGETS T = 0.03

SURFACE WATER PATHWAY (continued)
ENVIRONMENTAL THREAT WORKSHEET

When measuring length of wetlands that are located on both sides of a surface water body, sum both frontage lengths. For a sensitive environment that is more than one type, assign a value for each type.

ENVIRONMENTAL THREAT TARGETS	Score	Data Type	Refs

Record the water body type and flow for each surface water sensitive environment within the target distance (see SI Table 12). If there is no sensitive environment within the target distance limit, assign a score of 0 at the bottom of the page.

Environment Name	Water Body Type	Flow
[illegible]	[illegible]	[illegible] cfs
[illegible]	[illegible]	[illegible] cfs
		cfs
		cfs
		cfs

9. ACTUAL CONTAMINATION SENSITIVE ENVIRONMENTS: If sampling data or direct observation indicate any sensitive environment has been exposed to a hazardous substance from the site, record this information on SI Table 11, and assign a factor value for the environment (SI Tables 13 and 14).

Environment Name	Environment Type and Value (SI Tables 13 & 14)	Multiplier (10 for Level I, 1 for Level II)	Product
		x =	
		x =	
		x =	
		x =	

Sum =

10. POTENTIAL CONTAMINATION SENSITIVE ENVIRONMENTS:

Flow	Dilution Weight (SI Table 12)	Environment Type and Value (SI Tables 13 & 14)	Pot. Cont.	Product
[illegible] cfs	[illegible] x	[illegible] 250 x	0.1 =	[illegible]
[illegible] cfs	0.00001 x	[illegible] 50 x	0.1 =	[illegible]
cfs	x	x	0.1 =	
cfs	x	x	0.1 =	
cfs	x	x	0.1 =	

Sum = [illegible]

T = [illegible]

SI TABLE 12 (HRS Table 4-13): SURFACE WATER DILUTION WEIGHTS

Type of Surface Water Body		Assigned Dilution Weight
Descriptor	**Flow Characteristics**	
Minimal stream	< 10 cfs	1
Small to moderate stream	10 to 100 cfs	0.1
Moderate to large stream	> 100 to 1,000 cfs	0.01
Large stream to river	> 1,000 to 10,000 cfs	0.001
Large river	> 10,000 to 100,000 cfs	0.0001
Very large river	> 100,000 cfs	0.00001
Coastal tidal waters	Flow not applicable; depth not applicable	0.001
Shallow ocean zone or Great Lake	Flow not applicable; depth less than 20 feet	0.001
Moderate depth ocean zone or Great Lake	Flow not applicable; depth 20 to 200 feet	0.0001
Deep ocean zone or Great Lake	Flow not applicable; depth greater than 200 feet	0.000005
3-mile mixing zone in quiet flowing river	10 cfs or greater	0.5

SI TABLE 13 (HRS TABLE 4-23): SURFACE WATER AND AIR SENSITIVE ENVIRONMENTS VALUES

SENSITIVE ENVIRONMENT	*ASSIGNED VALUE*
Critical habitat for Federal designated endangered or threatened species Marine Sanctuary National Park Designated Federal Wilderness Area Ecologically important areas identified under the Coastal Zone Wilderness Act Sensitive Areas identified under the National Estuary Program or Near Coastal Water Program of the Clean Water Act Critical Areas identified under the Clean Lakes Program of the Clean Water Act (subareas in lakes or entire small lakes) National Monument (air pathway only) National Seashore Recreation Area National Lakeshore Recreation Area	100
Habitat known to be used by Federal designated or proposed endangered or threatened species National Preserve National or State Wildlife Refuge Unit of Coastal Barrier Resources System Coastal Barrier (undeveloped) *Federal land designated for the protection of natural ecosystems* Administratively Proposed Federal Wilderness Area Spawning areas critical for the maintenance of fish/shellfish species within a river system, bay, or estuary Migratory pathways and feeding areas critical for the maintenance of anadromous fish species within river reaches or areas in lakes or coastal tidal waters in which the fish spend extended periods of time Terrestrial areas utilized by large or dense aggregations of vertebrate animals (semi-aquatic foragers) for breeding National river reach designated as recreational	75
Habitat known to be used by State designated endangered or threatened species Habitat known to be used by a species under review as to its Federal endangered or threatened status *Coastal Barrier (partially developed)* Federally designated Scenic or Wild River	50
State land designated for wildlife or game management State designated Scenic or Wild River *State designated Natural Area* Particular areas, relatively small in size, important to maintenance of unique biotic communities	25
State designated areas for the protection of maintenance of aquatic life under the Clean Water Act	5
Wetlands See SI Table 14 (Surface Water Pathway) or SI Table 23 (Air Pathway)	

SI TABLE 14 (HRS TABLE 4-24): SURFACE WATER WETLANDS FRONTAGE VALUES

Total Length of Wetlands	Assigned Value
Less than 0.1 mile	0
0.1 to 1 mile	25
Greater than 1 to 2 miles	50
Greater than 2 to 3 miles	75
Greater than 3 to 4 miles	100
Greater than 4 to 8 miles	150
Greater than 8 to 12 miles	250
Greater than 12 to 16 miles	350
Greater than 16 to 20 miles	450
Greater than 20 miles	500

SURFACE WATER PATHWAY (concluded)

WASTE CHARACTERISTICS, THREAT, AND PATHWAY SCORE SUMMARY

WASTE CHARACTERISTICS	Score
14. If an Actual Contamination Target (drinking water, human food chain, or environmental threat) exists for the watershed, assign the calculated hazardous waste quantity score, or a score of 100, whichever is greater.	[illegible]
15. Assign the highest value from SI Table 7 (observed release) or SI Table 3 (no observed release) for the hazardous substance waste characterization factors below. Multiply each by the surface water hazardous waste quantity score and determine the waste characteristics score for each threat.	WC Score (from Table) (Maximum of 100)

	Substance Value		HWQ		Product	WC Score (from Table) (Maximum of 100)
Drinking Water Threat Toxicity/Persistence	[illegible]	x	[illegible]	=	[illegible]	32
Food Chain Threat Toxicity/Persistence Bioaccumulation	[illegible]	x		=	[illegible]	320
Environmental Threat Ecotoxicity/Persistence/ Ecobioaccumulation	[illegible]	x	[illegible]	=	[illegible]	320

Product	WC Score
0	0
>0 to <10	1
10 to <100	2
100 to <1,000	3
1,000 to < 10,000	6
10,000 to <1E + 05	10
1E + 05 to <1E + 06	18
1E + 06 to <1E + 07	32
1E + 07 to <1E + 08	56
1E + 08 to <1E + 09	100
1E + 09 to <1E + 10	180
1E + 10 to <1E + 11	320
1E + 11 to <1E + 12	560
1E + 12 or greater	1000

SURFACE WATER PATHWAY THREAT SCORES

Threat	Likelihood of Release (LR) Score	Targets (T) Score	Pathway Waste Characteristics (WC) Score (determined above)	Threat Score $\frac{LR \times T \times WC}{82,500}$
Drinking Water	313	0	32	(maximum of 100)
Human Food Chain	313 [illegible]	[illegible]	320	(maximum of 100) [illegible] 96
Environmental	313	0.0003	320	(maximum of 60) 0.00036

SURFACE WATER PATHWAY SCORE (Drinking Water Threat + Human Food Chain Threat + Environmental Threat)

(maximum of 100)
0.36

[illegible] 96.04

SOIL EXPOSURE PATHWAY

If there is no observed contamination (e.g., ground water plume with no known surface source), do not evaluate the soil exposure pathway. Discuss evidence for no soil exposure pathway.

Soil Exposure Resident Population Targets Summary

For each property (duplicate page 35 as necessary):

If there is an area of observed contamination on the property and within 200 feet of a residence, school, or day care center, enter on Table 15 each hazardous substance by sample ID. Record the detected concentration. Obtain cancer risk, and reference dose concentrations from SCDM. Sum the cancer risk and reference dose percentages for the substances listed. If cancer risk or reference dose concentrations are not available for a particular substance, enter N/A for the percentage. If the percentage sum calculated for cancer risk or reference dose equals or exceeds 100%, evaluate the residents and students as Level I. If both percentages are less than 100% or all are N/A, evaluate the targets as Level II.

SI TABLE 15: SOIL EXPOSURE RESIDENT POPULATION TARGETS

Residence ID: ______ Level I ______ Level II ______ Population ______

Sample ID	Hazardous Substance	Conc. (mg/kg)	Cancer Risk Concentration	% of Cancer Risk Conc.	RfD	% of RfD	Toxicity Value	References
			Highest Percent		Sum of Percents		Sum of Percents	

Residence ID: ______ Level I ______ Level II ______ Population ______

Sample ID	Hazardous Substance	Conc. (mg/kg)	Cancer Risk Concentration	% of Cancer Risk Conc.	RfD	% of RfD	Toxicity Value	References
			Highest Percent		Sum of Percents		Sum of Percents	

Residence ID: ______ Level I ______ Level II ______ Population ______

Sample ID	Hazardous Substance	Conc. (mg/kg)	Cancer Risk Concentration	% of Cancer Risk Conc.	RfD	% of RfD	Toxicity Value	References
			Highest Percent		Sum of Percents		Sum of Percents	

No

SOIL EXPOSURE PATHWAY WORKSHEET
RESIDENT POPULATION THREAT

LIKELIHOOD OF EXPOSURE	Score	Data Type	Refs
1. OBSERVED CONTAMINATION: If evidence indicates presence of observed contamination (depth of 2 feet or less), assign a score of 550; otherwise, assign a 0. Note that a likelihood of exposure score of 0 results in a soil exposure pathway score of 0.			
LE =	550		

TARGETS	Score	Data Type	Refs
2. RESIDENT POPULATION: Determine the number of people occupying residences or attending school or day care on or within 200 feet of areas of observed contamination (HRS section 5.1.3). Level I: ______ people x 10 = ______ Level II: ______ people x 1 = ______ Sum =			
3. RESIDENT INDIVIDUAL: Assign a score of 50 if any Level I resident population exists. Assign a score of 45 if there are Level II targets but no Level I targets. If no resident population exists (*i.e.*, no Level I or Level II targets), assign 0 (HRS Section 5.1.3).			
4. WORKERS: Assign a score from the table below for the total number of workers at the site and nearby facilities with areas of observed contamination associated with the site.			
5. TERRESTRIAL SENSITIVE ENVIRONMENTS: Assign a value for each terrestrial sensitive environment (SI Table 16) in an area of observed contamination. Sum =			
6. RESOURCES: Assign a score of 5 if any one or more of the following resources is present on an area of observed contamination at the site; assign 0 if none applies. • Commercial agriculture • Commercial silviculture • Commercial livestock production or commercial livestock grazing			
Total of Targets T=			

Workers table (item 4):

Number of Workers	Score
0	0
1 to 100	5
101 to 1,000	10
>1,000	15

Terrestrial sensitive environments table (item 5):

Terrestrial Sensitive Environment Type	Value

SI TABLE 16 (HRS TABLE 5-5): SOIL EXPOSURE PATHWAY TERRESTRIAL SENSITIVE ENVIRONMENT VALUES

TERRESTRIAL SENSITIVE ENVIRONMENT	ASSIGNED VALUE
Terrestrial critical habitat for Federal designated endangered or threatened species National Park Designated Federal Wilderness Area National Monument	100
Terrestrial habitat known to be used by Federal designated or proposed threatened or endangered species National Preserve (terrestrial) National or State terrestrial Wildlife Refuge Federal land designated for protection of natural ecosystems Administratively proposed Federal Wilderness Area Terrestrial areas utilized by large or dense aggregations of animals (vertebrate species) for breeding	75
Terrestrial habitat used by State designated endangered or threatened species Terrestrial habitat used by species under review for Federal designated endangered or threatened status	50
State lands designated for wildlife or game management State designated Natural Areas Particular areas, relatively small in size, important to maintenance of unique biotic communities	25

SOIL EXPOSURE PATHWAY WORKSHEET
NEARBY POPULATION THREAT

LIKELIHOOD OF EXPOSURE	Score	Data Type	Ref.
7. Attractiveness/Accessibility (from SI Table 17 or HRS Table 5-6) Value 5 Area of Contamination (from SI Table 18 or HRS Table 5-7) Value 30 Likelihood of Exposure (from SI Table 19 or HRS Table 5-8)		[illegible]	[illegible]
LE =	25		

TARGETS	Score	Data Type	Ref.
8. Assign a score of 0 if Level I or Level II resident individual has been evaluated or if no individuals live within 1/4 mile travel distance of an area of observed contamination. Assign a score of 1 if nearby population is within 1/4 mile travel distance and no Level I or Level II resident population has been evaluated.	0	[illegible]	[illegible]
9. Determine the population within 1 mile travel distance that is not exposed to a hazardous substance from the site (*i.e.*, properties that are not determined to be Level I or Level II); record the population for each distance category in SI Table 20 (HRS Table 5-10). Sum the population values and multiply by 0.1.	1		[illegible]
T =	1		

SI TABLE 17 (HRS TABLE 5-6): ATTRACTIVENESS/ACCESSIBILITY VALUES

Area of Observed Contamination	Assigned Value
Designated recreational area	100
Regularly used for public recreation (for example, vacant lots in urban area)	75
Accessible and unique recreational area (for example, vacant lots in urban area)	75
Moderately accessible (may have some access improvements–for example, gravel road) with some public recreation use	50
Slightly accessible (for example, extremely rural area with no road improvement) with some public recreation use	25
Accessible with no public recreation use	10
Surrounded by maintained fence or combination of maintained fence and natural barriers	5
Physically inaccessible to public, with no evidence of public recreation use	0

SI TABLE 18 (HRS TABLE 5-7): AREA OF CONTAMINATION FACTOR VALUES

Total area of the areas of observed contamination (square feet)	Assigned Value
≤ to 5,000	5
> 5,000 to 125,000	20
> 125,000 to 250,000	40
> 250,000 to 375,000	60
> 375,000 to 500,000	80
> 500,000	100

SI TABLE 19 (HRS TABLE 5-8): NEARBY POPULATION LIKELIHOOD OF EXPOSURE FACTOR VALUES

AREA OF CONTAMINATION FACTOR VALUE	ATTRACTIVENESS/ACCESSIBILITY FACTOR VALUE						
	100	75	50	25	10	5	0
100	500	500	375	250	125	50	0
80	500	375	250	125	50	25	0
60	375	250	125	50	25	5	0
40	250	125	50	25	5	5	0
20	125	50	25	5	5	5	0
5	50	25	5	5	5	5	0

SI TABLE 20 (HRS TABLE 5-10): DISTANCE-WEIGHTED POPULATION VALUES FOR NEARBY POPULATION THREAT

Travel Distance Category (miles)	Pop.	Number of people within the travel distance category												Pop. Value
		0	1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,001	10,001 to 30,000	30,001 to 100,000	100,001 to 300,000	300,001 to 1,000,000	
Greater than 0 to $\frac{1}{4}$	0	0	0.1	0.4	1.0	4	13	41	130	408	1,303	4,081	13,034	
Greater than $\frac{1}{4}$ to $\frac{1}{2}$	0	0	0.05	0.2	0.7	2	7	20	65	204	652	2,041	6,517	
Greater than $\frac{1}{2}$ to 1	[illegible]	0	0.02	0.1	0.3	1	3	10	33	102	326	1,020	3,258	

Reference(s) ____________ Sum =

SOIL EXPOSURE PATHWAY WORKSHEET (concluded)

WASTE CHARACTERISTICS

10.	Assign the hazardous waste quantity score calculated for soil exposure	
11.	Assign the highest toxicity value from SI Table 16	
12.	Multiply the toxicity and hazardous waste quantity scores. Assign the Waste Characteristics score from the table below:	WC =

Product	WC Score
0	0
>0 to <10	1
10 to <100	2
100 to <1,000	3
1,000 to < 10,000	6
10,000 to <1E + 05	10
1E + 05 to <1E + 06	18
1E + 06 to <1E + 07	32
1E + 07 to <1E + 08	56
1E + 08 or greater	100

RESIDENT POPULATION THREAT SCORE:

(Likelihood of Exposure, Question 1;
Targets = Sum of Questions 2, 3, 4, 5, 6)

$\frac{LE \times T \times WC}{82,500}$

NEARBY POPULATION THREAT SCORE:

(Likelihood of Exposure, Question 7;
Targets = Sum of Questions 8, 9)

$\frac{LE \times T \times WC}{82,500}$

SOIL EXPOSURE PATHWAY SCORE:
Resident Population Threat + Nearby Population Threat

(Maximum of 100)

AIR PATHWAY

Air Pathway Observed Substances Summary Table

On SI Table 21, list the hazardous substances detected in air samples of a release from the site. Include only those substances with concentrations significantly greater than background levels. Obtain benchmark, cancer risk, and reference dose concentrations from SCDM. For NAAQS/NESHAPS benchmarks, determine the highest percentage of benchmark obtained for any substance. For cancer risk and reference dose, sum the percentages for the substances listed. If benchmark, cancer risk, or reference dose concentrations are not available for a particular substance, enter N/A for the percentage. If the highest benchmark percentage or the percentage sum calculated for cancer risk or reference dose equals or exceeds 100%, evaluate targets in the distance category from which the sample was taken and any closer distance categories as Level I. If the percentages are less than 100% or all are N/A, evaluate targets in that distance category and any closer distance categories that are not Level I as Level II.

AIR PATHWAY WORKSHEET

LIKELIHOOD OF RELEASE	Score	Data Type	Refs
1. OBSERVED RELEASE: If sampling data or direct observation support a release to air, assign a score of 550. Record observed release substances on SI Table 21.	–		
2. POTENTIAL TO RELEASE: If sampling data do not support a release to air, assign a score of 500. Optionally, evaluate air migration gaseous and particulate potential to release (HRS Section 6.1.2).	500	–	
LR =	500		

TARGETS	Score	Data Type	Refs
3. ACTUAL CONTAMINATION POPULATION: Determine the number of people within the target distance limit subject to exposure from a release of a hazardous substance to the air. a) Level I: _____ people x 10 = _______ b) Level II: _____ people x 1 = _______ Total =	0		
4. POTENTIAL TARGET POPULATION: Determine the number of people within the target distance limit not subject to exposure from a release of a hazardous substance to the air, and assign the total population score from SI Table 22. Sum the values and multiply the sum by 0.1.	16.4		
5. NEAREST INDIVIDUAL: Assign a score of 50 if there are any Level I targets. Assign a score of 45 if there are Level II targets but no Level I targets. If no Actual Contamination Population exists, assign the Nearest Individual score from SI Table 22.	1		
6. ACTUAL CONTAMINATION SENSITIVE ENVIRONMENTS: Sum the sensitive environment values (SI Table 13) and wetland acreage values (SI Table 23) for environments subject to exposure from the release of a hazardous substance to the air. *Sensitive Environment Type* / *Value*: ________ *Wetland Acreage* / *Value*: ________	0		
7. POTENTIAL CONTAMINATION SENSITIVE ENVIRONMENTS: Use SI Table 24 to evaluate sensitive environments not subject to exposure from a release.	0.335		
8. RESOURCES: Assign a score of 5 if one or more air resources apply within 1/2 mile of a source; assign a 0 if none applies. • Commercial agriculture • Commercial silviculture • Major or designated recreation area	0		
T =	17.74		

SI TABLE 21: AIR PATHWAY OBSERVED RELEASE SUBSTANCES

Sample ID: ______ Level I ______ Level II ______ Distance from Sources (mi) ______ References ______

Hazardous Substance	Conc. ($\mu g/m^3$)	Gaseous Particulate	Benchmark Conc. (NAAQS or NESHAPS)	% of Benchmark	Cancer Risk Conc.	% of Cancer Risk Conc.	RfD	% of RfD
	Highest Toxicity/ Mobility		Highest Percent		Sum of Percents		Sum of Percents	

Sample ID: ______ Level I ______ Level II ______ Distance from Sources (mi) ______ References ______

Hazardous Substance	Conc. ($\mu g/m^3$)	Toxicity/ Mobility	Benchmark Conc. (NAAQS or NESHAPS)	% of Benchmark	Cancer Risk Conc.	% of Cancer Risk Conc.	RfD	% of RfD
	Highest Toxicity/ Mobility		Highest Percent		Sum of Percents		Sum of Percents	

Sample ID: ______ Level I ______ Level II ______ Distance from Sources (mi) ______ References ______

Hazardous Substance	Conc. ($\mu g/m^3$)	Toxicity/ Mobility	Benchmark Conc. (NAAQS or NESHAPS)	% of Benchmark	Cancer Risk Conc.	% of Cancer Risk Conc.	RfD	% of RfD
	Highest Toxicity/ Mobility		Highest Percent		Sum of Percents		Sum of Percents	

SI TABLE 22 (From HRS TABLE 6-17): VALUES FOR POTENTIAL CONTAMINATION AIR TARGET POPULATIONS

Distance from Site	Pop.	Nearest Individual (choose highest)	Number of People within the Distance Category: 1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	100,001 to 300,000	300,001 to 1,000,000	1,000,000 to 3,000,000	Pop. Value
On a source	0	20	4	17	53	164	522	1,633	5,214	16,325	52,137	163,246	521,360	1,632,455	
0 to $\frac{1}{4}$ mile	0	*	1	4	13	41	131	408	1,304	4,081	13,034	40,812	130,340	408,114	
> $\frac{1}{4}$ to $\frac{1}{2}$ mile	0	2	0.2	0.9	3	9	28	88	282	882	2,815	8,815	28,153	88,153	
> $\frac{1}{2}$ to 1 mile	[illegible]	1	0.06	0.3	0.9	3	8	26	83	261	834	2,612	8,342	26,119	[illegible]
> 1 to 2 miles	[illegible]	0	0.02	0.09	0.3	0.8	3	8	27	83	266	833	2,659	8,326	[illegible]
> 2 to 3 miles	[illegible]	0	0.009	0.04	0.1	0.4	1	4	12	38	120	375	1,199	3,755	
>3 to 4 miles	[illegible]	0	0.005	0.02	0.07	0.2	0.7	2	7	28	73	229	730	2,285	[illegible]

Nearest Individual = 1

Sum =

References 35

* Score = 20 if the Nearest Individual is within $\frac{1}{8}$ mile of a source; score = 7 if the Nearest Individual is between $\frac{1}{8}$ and $\frac{1}{4}$ mile of a source.

SI TABLE 23 (HRS TABLE 6-18): AIR PATHWAY VALUES FOR WETLAND AREA

Wetland Area	Assigned Value
< 1 acre	0
1 to 50 acres	25
> 50 to 100 acres	75
> 100 to 150 acres	125
> 150 to 200 acres	175
> 200 to 300 acres	250
> 300 to 400 acres	350
> 400 to 500 acres	450
> 500 acres	500

SI TABLE 24: DISTANCE WEIGHTS AND CALCULATIONS FOR AIR PATHWAY POTENTIAL CONTAMINATION SENSITIVE ENVIRONMENTS

Distance	Distance Weight	Sensitive Environment Type and Value (from SI Tables 13 and 20)	Product
On a Source	0.10	x –	
		x –	
0 to 1/4 mile	0.025	x –	
		x –	
		x –	
1/4 to 1/2 mile	0.0054	x [illegible] 75	[illegible]
		x	
		x	
1/2 to 1 mile	0.0016	x [illegible] 70 [illegible]	[illegible]
		x [illegible]	
		x	
1 to 2 miles	0.0005	x	
		x	
		x	
2 to 3 miles	0.00023	x	
		x	
		x	
3 to 4 miles	0.00014	x	
		x	
		x	
> 4 miles	0	x	

Total Environments Score =

AIR PATHWAY (concluded)

WASTE CHARACTERISTICS

9.	If any Actual Contamination Targets exist for the air pathway, assign the calculated hazardous waste quantity score or a score of 100, whichever is greater; if there are no Actual Contamination Targets for the air pathway, assign the calculated HWQ score for sources available to air migration.	[illegible]
10.	Assign the highest air toxicity/mobility value from SI Table 21.	10,000
11.	Multiply the air pathway toxicity/mobility and hazardous waste quantity scores. Assign the Waste Characteristics score from the table below:	WC = 32

Product	WC Score
0	0
>0 to <10	1
10 to <100	2
100 to <1,000	3
1,000 to < 10,000	6
10,000 to <1E + 05	10
1E + 05 to <1E + 06	18
1E + 06 to <1E + 07	32
1E + 07 to <1E + 08	56
1E + 08 or greater	100

AIR PATHWAY SCORE: $\frac{LE \times T \times WC}{82,500}$ 8.44 (maximum of 100)

100 x [illegible] x 32

SITE SCORE CALCULATION	S	S^2
GROUND WATER PATHWAY SCORE (S_{GW})	[illegible]	[illegible]
SURFACE WATER PATHWAY SCORE (S_{sw})	[illegible]	[illegible]
SOIL EXPOSURE (S_S)	[illegible]	[illegible]
AIR PATHWAY SCORE (S_A)	[illegible]	[illegible]
SITE SCORE $\sqrt{\dfrac{S_{GW}^2+S_{SW}^2+S_S^2+S_A^2}{4}}$ =		I → 2.43 II → 14.07 III → 48.10

COMMENTS

Scenario I [illegible]

[illegible]

[illegible] 3 [illegible]

[illegible]

PCB [illegible]

[illegible] 5.59 [illegible]

Scenario 2 is based [illegible]

[illegible]

Soil [illegible] indicates

a score of 14.07

LATITUDE AND LONGITUDE CALCULATION WORKSHEET #2
LI USING ENGINEER'S SCALE (1/60)

SITE NAME: International Harvester CERCLIS #: TND 00700...

AKA: ______ SSID: ______

ADDRESS: 3003 Harvester Lane

CITY: Memphis STATE: TN ZIP CODE: 38127

SITE REFERENCE POINT: ______

USGS QUAD MAP NAME: Northwest Memphis TN-AR TOWNSHIP: ____ N/S RANGE: ____ E/W

SCALE: 1:24,000 MAP DATE: 1965 | Photo revised 1973 SECTION: ____ 1/4 ____ 1/4 ____ 1/4

MAP DATUM: 1927 1983 (CIRCLE ONE) MERIDIAN: ______

COORDINATES FROM LOWER RIGHT (SOUTHEAST) CORNER OF 7.5' MAP (attach photocopy):

LONGITUDE: 90° 00' 00" LATITUDE: 35° 07' 30"

COORDINATES FROM LOWER RIGHT (SOUTHEAST) CORNER OF 2.5' GRID CELL:

LONGITUDE: 90° 02' 30" LATITUDE: 35° 10' 00"

CALCULATIONS: LATITUDE (7.5' QUADRANGLE MAP)

A) NUMBER OF RULER GRADUATIONS FROM LATITUDE GRID LINE TO SITE REF POINT: 437

B) MULTIPLY (A) BY ~~0.3304~~ 0.3297 TO CONVERT TO SECONDS:

A x ~~0.3304~~ 0.3297 = 144.08"

C) EXPRESS IN MINUTES AND SECONDS (1'= 60"): 02' 24.08"

D) ADD TO STARTING LATITUDE: 35° 10' 00.00" + 02' 24.08" =

SITE LATITUDE: 35° 12' 24.08"

CALCULATIONS: LONGITUDE (7.5' QUADRANGLE MAP)

A) NUMBER OF RULER GRADUATIONS FROM RIGHT LONGITUDE LINE TO SITE REF POINT: 84

B) MULTIPLY (A) BY ~~0.4178~~ 0.4005 TO CONVERT TO SECONDS:

A x ~~0.4178~~ 0.4005 = 33.64"

C) EXPRESS IN MINUTES AND SECONDS (1'= 60"): 00' 33.64"

D) ADD TO STARTING LONGITUDE: 90° 02' 30.00" + 00' 33.64" = 90° 03' 03.64"

SITE LONGITUDE: 90° 03' 03.64"

INVESTIGATOR: Robert Martel DATE: 07/09/93

Reference 2

SOIL SURVEY

Shelby County Tennessee

SOIL CONSERVATION SERVICE
7777 Walnut Grove Rd., Box [illegible]
Memphis, TN 38120

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
TENNESSEE AGRICULTURAL EXPERIMENT STATION

Figure 2.—**Highway I–40, 5 miles east of the city limits of Memphis. Superhighways like this take large areas that once were farms.**

The 2,052 farms in Shelby County take up 273,387 acres, or 56.6 percent of the land area. The average acreage per farm is 133.2 acres. Farms 10 to 49 acres in size are the most common. There are 992 farms in this size range and 266 farms less than 10 acres in size. There are few farms more than 500 acres in size, but there are 394 farms between 100 and 500 acres in size.

Most of the farms in the county are listed as field-crop farms, with cotton farms and miscellaneous and unclassified farms following closely. Livestock, cash-grain, general, and dairy farms follow in the order given. Soybeans were grown on 51,393 acres; cotton, on 33,728 acres; and corn, on 12,135 acres, in 1964. Vegetable crops, though not extensive in acreage, are important.

Annual lespedeza and alfalfa are the leading hay crops. They generally are fed on the farm, not sold as hay.

Unimproved pastures consist mostly of common lespedeza. Improved pastures consist mostly of tall fescue, white clover, and common bermudagrass.

Shelby County has a complete drainage system. All of the surface runoff flows into the Mississippi River. Nonconnah Creek and the Wolf River are the major drains in the southern part of the county. Big Creek and the Loosahatchie River are the major drains in the northern part of the county.

Climate [1]

The climate of Shelby County, like that of much of Tennessee and of surrounding areas, is characterized by relatively mild winters, hot summers, and abundant rainfall. Although the county is well inland from large bodies of water, it lies in the path of cold air moving down from Canada and warm, moist air moving up from the Gulf of Mexico. Consequently, extreme and frequent changes in the weather, both from day to day and from season to season, are common.

Although the weather varies daily within the county, differences in altitude are not great enough to cause significant differences in climate. Therefore, the climate data for Memphis in table 1 are representative of the entire county, except that precipitation decreases slightly from east to west. The difference between the total annual precipitation in the eastern part of the county and that in the western part is about 2 inches.

TEMPERATURE.—The average annual temperature at Memphis is 62° F. Extremes of 106° and −11° occurred during the period 1931 through 1960. Prolonged periods of very cold or very hot weather are unusual. Occasional

[1] By JOHN VAIKSNORIS, State climatologist, U.S. Weather Bureau, Nashville, Tennessee.

GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. The capability units are not discussed separately. For discussion of the suitability of a given soil for crops and pasture, for woodland, for wildlife, and for lawn grasses and shrubs, see the discussion of the mapping unit. Other information is given in tables as follows:

Acreage and extent, table 2, page 11.
Estimated yields, table 3, page [illegible].
Engineering uses of the soils, table 4, page [illegible]; table 5, page 44.
Nonfarm uses of the soils, table 6, page 48.

Map symbol	Mapping unit	Described on page	Capability unit Symbol
Ad	Adler silt loam	[illegible]	I-2
Bo	Bonn silt loam	[illegible]	IVw-1
Bw	Bowdre silty clay	[illegible]	IIw-1
Ca	Calloway silt loam	[illegible]	IIIw-2
Co	Collins silt loam	14	I-2
Cr	Commerce silt loam	14	I-2
Cs	Convent silt loam	[illegible]	IIw-1
Cu	Crevasse fine sand	[illegible]	IVs-1
Cv	Crevasse silt loam	[illegible]	IVs-1
Fm	Falaya silt loam	[illegible]	IIw-1
Fs	Filled land, silty	[illegible]	None
Fy	Filled land, sandy	[illegible]	None
GaA	Grenada silt loam, 0 to 2 percent slopes	[illegible]	IIw-2
GaB	Grenada silt loam, 2 to 5 percent slopes	[illegible]	IIe-2
GaB2	Grenada silt loam, 2 to 5 percent slopes, eroded	[illegible]	IIIe-2
GaC	Grenada silt loam, 5 to 8 percent slopes	[illegible]	IIIe-2
GaC3	Grenada silt loam, 5 to 8 percent slopes, severely eroded	[illegible]	IVe-2
GaD	Grenada silt loam, 8 to 12 percent slopes	[illegible]	IVe-2
GaD2	Grenada silt loam, 8 to 12 percent slopes, eroded	[illegible]	VIe-2
GgD3	Grenada complex, 5 to 12 percent slopes, severely eroded	[illegible]	VIe-2
Gr	Graded land, silty materials	[illegible]	None
Gs	Gullied land, silty	[illegible]	VIIe-2
He	Henry silt loam	[illegible]	IIIw-1
Ib	Iberia silt loam	[illegible]	IIIw-3
Lb	Levees and Borrow Pits	[illegible]	VIe-3
LoB	Loring silt loam, 2 to 5 percent slopes	[illegible]	IIe-1
LoB2	Loring silt loam, 2 to 5 percent slopes, eroded	[illegible]	IIIe-1
LoC2	Loring silt loam, 5 to 8 percent slopes, eroded	[illegible]	IIIe-1
LoD	Loring silt loam, 8 to 12 percent slopes	[illegible]	IVe-1
LoD2	Loring silt loam, 8 to 12 percent slopes, eroded	[illegible]	IVe-1
LoD3	Loring silt loam, 5 to 12 percent slopes, severely eroded	28	VIe-1
MeB	Memphis silt loam, 2 to 5 percent slopes	[illegible]	IIe-1
MeB2	Memphis silt loam, 2 to 5 percent slopes, eroded	[illegible]	IIIe-1
MeC2	Memphis silt loam, 5 to 8 percent slopes, eroded	[illegible]	IIIe-1
MeD2	Memphis silt loam, 8 to 12 percent slopes, eroded	31	IVe-1
MeD3	Memphis silt loam, 5 to 12 percent slopes, severely eroded	31	IVe-1
MeE	Memphis silt loam, 12 to 20 percent slopes	31	VIe-1
MeF3	Memphis silt loam, 12 to 30 percent slopes, severely eroded	32	VIe-1
MeG	Memphis silt loam, 30 to 65 percent slopes	[illegible]	VIIe-1
Rb	Robinsonville fine sandy loam	33	I-1
Rn	Robinsonville silt loam	33	I-1
Sh	Sharkey clay	33	IIIw-3
Sw	Swamp	34	VIIw-1
Tu	Tunica silty clay	34	IIIw-3
Wv	Waverly silt loam	35	IIIw-1

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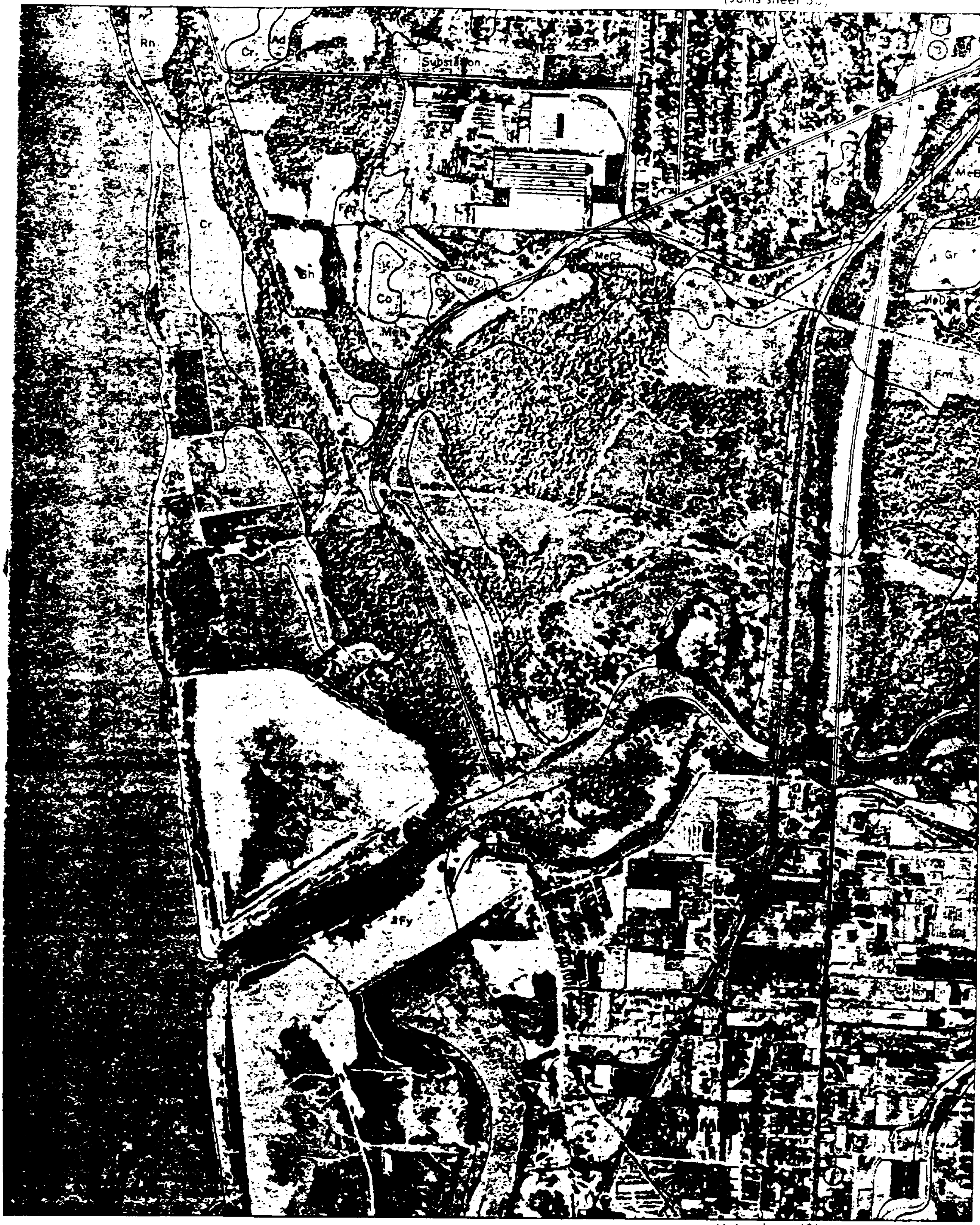
(Joins sheet 33)



(Joins sheet 42)

0 ¼ ½ ¾ 1

1 Mile

(Joins sheet 48)

acid to neutral in reaction. It is flooded every few years.

Only a small acreage has been cleared. Most of the cleared area is idle or in bermudagrass pasture. Droughtiness limits the choice of crops to small grain, pasture, and other crops that grow in winter and spring, when moisture is most plentiful.

About three-fourths of the acreage is woodland. The trees are mainly cottonwood, black willow, and hackberry. In places the stand is thin, although the site is moderately good for cottonwood and black willow. Because of droughtiness, the loss of a fourth to a half of the seedlings in both planted and natural stands is to be expected.

The droughty nature of this soil limits the choice of plants that can be grown to provide food for wildlife. Plants that grow in winter and spring when available moisture is most plentiful are suitable. Winter small grains grow well if flooding is not severe. Sunflowers and sorghum also grow well. (Capability unit IVs-1)

Crevasse silt loam (Cv).—This is an excessively drained soil that occurs along the Mississippi River, as tracts 10 to 80 acres in size. The surface layer is silt loam or loam 6 to 10 inches thick. The substratum is almost pure sand. It extends to a depth of 4 feet or more. The slope range is 0 to 3 percent. Most areas have an uneven surface.

Included in mapping were a few areas that have a slightly finer textured substratum.

Crevasse silt loam has a low available water capacity and is extremely droughty. It is slightly acid to neutral in reaction and does not need lime. It is flooded every 5 to 10 years.

This soil is suited to small grain, pasture, and other crops that grow in winter and spring when moisture is most plentiful. It is fairly well suited to deep-rooted crops, such as alfalfa, but is too droughty for cotton and soybeans.

Droughtiness is the main limitation. This limitation can be partly overcome by selecting plants that grow when moisture is most plentiful. Flooding is a minor limitation.

Very little of the acreage is woodland. The site is moderately good for cottonwood and black willow. Because of droughtiness, the loss of about a fourth of the seedlings in both planted and natural stands is to be expected.

The droughty nature of this soil limits the choice of plants that can be grown for wildlife. Plants that have deep root systems or plants that grow in winter and spring are best suited. Small grains, sorghum, and sunflowers can be grown to provide food for wildlife. (Capability unit IVs-1)

Falaya Series

This series consists of somewhat poorly drained, strongly acid, nearly level, silty soils on bottom lands.

Representative profile of Falaya silt loam, 100 feet north of Raines Road, three-fourths of a mile east of Outland Road:

Ap—0 to 6 inches, brown (10YR 4/3) silt loam; weak, fine, granular structure; very friable; strongly acid; clear, smooth boundary.

C1—6 to 18 inches, brown (10YR 5/3) [illegible] loam; common, [illegible], light brownish-gray and [illegible] mottles; structureless; friable; strongly [illegible]; clear, smooth boundary.

C2—18 to 28 inches, light brownish-gray (10YR [illegible]) silt loam; common, medium, [illegible] mottles; massive; friable; many, small, hard [illegible]; strongly acid; gradual, smooth boundary.

C3—28 to 50 inches, dark-gray (10YR [illegible]) silt loam; common, medium, light brownish-gray, yellowish-brown, and gray mottles; massive; friable; many, small, brown, hard concretions; strongly acid.

The color of the surface layer ranges from brown to dark grayish brown. The C horizon has a high content of silt. The content of sand is no more than 15 percent and is commonly less than 10 percent.

Falaya silt loam (Fa).—This is a somewhat poorly drained, very silty, nearly level soil on first bottoms. It occurs throughout the county, except on the Mississippi River bottoms. The surface layer is brown, friable silt loam about 6 inches thick. The underlying material is friable silt loam that contains brown and gray mottles. It extends to a depth of several feet.

Included in mapping were some areas, in the vicinity of Woodstock and Millington, that are underlain with very dark gray to black silt loam or silty clay loam at a depth of 18 to 30 inches. Also included were small sandy spots in the eastern part of the county.

In winter and early in spring, the water table is often within a foot of the surface. In summer and fall it is several feet below the surface. Floods cover most areas during winter and spring, but the floodwater seldom stands more than a few hours.

This soil is easy to work after it dries out in spring. The lowest areas, however, are wet fairly late in spring (fig. 7). The available water capacity is high. The reaction is medium acid or strongly acid, and the content of phosphorus and potassium is moderately high. Crops respond to lime and fertilizer.

If adequately limed and fertilized and otherwise well managed, this soil is well suited to nearly all the commonly grown crops. Small grains can be grown if surface drainage is good and if flooding is not severe. Because of wetness, stands of alfalfa are not long lived. Tall fescue, annual lespedeza, and bermudagrass are suitable pasture plants. The surface is too wet and too soft for grazing during much of winter and early in spring. Nearly all of the acreage is used to grow cotton, corn, soybeans (fig. 8), pasture plants, and truck crops. Plowing under crop residue helps to maintain the organic-matter content.

Excess water is the main limitation. This limitation can be largely overcome by using a system of drainage ditches or tile and by selecting plants that tolerate wetness in winter and spring.

Some of the acreage is woodland. The site is excellent for bottom-land oaks, sweetgum, cottonwood, and other bottom-land hardwoods. Plant competition is severe. Weeding is needed in existing stands to promote reproduction of desirable species and to eliminate cull trees. Weeding is needed in planted stands to insure survival of seedlings.

This soil is well suited to many summer annuals that furnish food and cover for bobwhite quail, doves, and rabbits. Wastes left when corn and soybeans are har-

Figure 9.—Severely eroded, strongly sloping Grenada soil. Light-colored areas show where the fragipan is exposed or is close to the surface.

Most of this soil is idle and is either bare of vegetation or has a scrubby growth of weeds, broomsedge, briers, and bushes. It is poorly suited to row crops because of the slope and the erosion hazard. Only a small acreage is cultivated. Grasses and legumes that have shallow root systems or roots that can penetrate the fragipan can be grown. These include tall fescue, sericea lespedeza, and annual lespedeza.

The slope and the compact subsoil make management difficult. Well-fertilized hay and pasture help to control runoff and erosion.

The site is fair for pine trees, but productivity varies greatly from place to place because of differences in erosion and thickness of root zone. Seedling mortality ranges from slight to severe. The hazard of erosion is severe.

Most of this soil has only a sparse cover that provides little food or cover for wildlife. Tall fescue, sericea lespedeza, and annual lespedeza are fairly well suited, and they furnish some food for wildlife. (Capability unit VIe-2)

Graded land, silty materials (Gr).—This land type consists of areas that have been graded in preparation for subdivisions (fig. 10) and for commercial and industrial building. The depth to which these areas have been graded varies from a few inches to 5 feet or more and is most commonly about 3 feet. The slope, after grading, is generally between 1 and 5 percent.

Grenada, Loring, and Memphis soils were predominant in these areas before grading. In most areas the original soil profiles have been disturbed to such an extent that they no longer can be identified. The soil material is brown, yellowish brown, and dark brown in color and silty in texture.

The areas of this land type range in size from a few acres to about 400 acres. They are on the outer edges of the city of Memphis and in the county just outside the city. Included in some of the areas mapped were small areas of Filled land, silty.

Lawn grasses and ornamental plants and trees grow well if a good seedbed is prepared and enough fertilizer and water are applied. (Not in a capability unit)

Gullied land, silty (Gs).—This land type occurs as tracts 5 to 20 acres in size. It is mostly on hillsides where the slope ranges from 8 to 20 percent. Gullies make up 25 percent or more of each area. The gullies range from 3 to 15 feet in depth and from 5 to 80 feet in width. Except in small patches and narrow strips, the soil profiles have been destroyed. Between the gullies, sheet erosion has removed much of the original surface layer and subsoil. In some gullies sandy and gravelly Coastal Plain material is exposed.

clover, bermudagrass, and lespedeza are suitable hay and pasture plants. Many kinds of grasses and legumes grow well under good management. Grazing is possible during winter because the surface is not wet and soft.

This soil erodes easily if not protected. Control of runoff is the main management problem. Well fertilized pastures of grasses and legumes, if not overgrazed or mowed too closely, help to reduce runoff and to limit erosion.

The wooded tracts are fairly small. The existing stands consist of many kinds of upland hardwoods. The site is good for white oak, red oak, yellow-poplar, black walnut, and other upland hardwoods and for loblolly pine. Plant competition is moderate. The hazard of erosion is severe. Because of a lack of suitable seed trees, natural regeneration cannot always be relied upon to provide adequate restocking of high-value trees. In natural stands it may be necessary to plant seedlings and remove cull trees, low-value trees, and bushes. Abandoned fields and openings where planting is needed may need site preparation, cultivation, and weeding. Unnecessary disturbance of the soil should be avoided.

Many annual and perennial plants that furnish food and cover for wildlife can be grown on this soil. Crops such as annual lespedeza contribute to the food supply. Autumn olive, sericea lespedeza, shrub lespedeza, and pyracantha are among the perennials that can be planted in odd-shaped fields and field borders. In wooded areas, oak, hickory, beech, black walnut, and dogwood trees provide some food and cover for wildlife, especially for squirrels. (Capability unit VIe-1)

Memphis silt loam, 12 to 30 percent slopes, severely eroded (MeF3).—This is a deep soil on hillsides. It occurs as tracts 10 to 50 acres in size, mostly in the western half of the county. Erosion has removed most of the original surface layer and much of the subsoil. The plow layer consists mostly of brown, friable silt loam that originally was subsoil material. It is about 4 inches thick. The uppermost 6 inches of the subsoil is brown, friable silty clay loam. Below this is brown silt loam that extends to a depth of several feet. In many places erosion has removed the silty clay loam layer, and the texture throughout the profile is silt loam. There are many rills and gullies, and the surface is uneven.

This soil is strongly acid to slightly acid in reaction and moderately high in natural fertility. The response to lime and fertilizer is good. Roots, water, and air penetrate readily. The available water capacity is high. If runoff is controlled, plants generally have a good supply of moisture.

Because of rapid runoff and the severe hazard of erosion, this soil is poorly suited to row crops. The slope and the uneven surface make the operation of farm machinery difficult. Most areas are idle and have a scrubby growth of briers, bushes, cedars, and volunteer grasses. Some areas are in pasture. Tall fescue, white clover, bermudagrass, and lespedeza are among the suitable hay and pasture crops. Many kinds of grasses and legumes grow well under good management. Grazing is possible during winter because the surface does not get too wet and too soft.

This soil erodes easily if not protected. Control of runoff is the main management problem. Well-fertilized pastures of grasses and legumes, if not overgrazed or mowed too closely, help to reduce runoff and limit erosion.

The site is fairly good for loblolly pine, which can be used as a nurse crop to reestablish upland hardwoods. Plant competition is moderate. Abandoned fields where planting is needed may need site preparation and weeding. The slope is a moderate limitation on the use of equipment. If unprotected, the soil erodes rapidly. Gully erosion is especially likely. Because of the severe hazard of erosion, protection must be provided if roads and trails are built.

This soil is too steep and too eroded to be cultivated every year, but annual and perennial plants that provide food and cover for wildlife can be grown. The plants in idle areas furnish some food and cover. Autumn olive, sericea lespedeza, shrub lespedeza, and annual lespedeza are among the plants that can be grown to attract birds. (Capability unit VIe-1)

Memphis silt loam, 30 to 65 percent slopes (MeG).—This is a well drained soil on hillsides that form deep, narrow, meandering, V-shaped valleys as they slope from the narrow, winding ridgetops. The soil formed in loess 20 to 80 feet thick. It occurs as large tracts on the steep bluffs adjacent to the Mississippi River bottoms. The surface layer is brown, very friable silt loam 5 to 8 inches thick. In the uppermost 3 inches there are dark stains from decayed leaves. The subsoil is brown, friable silt loam several feet thick. The depth to alkaline loess ranges from 4 to 6 feet. A few gullies have formed in most areas. Included in mapping were a few areas where the soil is underlain by sand at a depth of 30 to 40 inches.

This soil is medium acid in reaction and moderately high in natural fertility. It is readily penetrated by roots, water, and air. The available water capacity is high, and the root zone is deep. Plants generally have a good supply of moisture.

Very little of this soil has been cleared. Because of the slope, it is unsuited to crops, pasture, or hay. Surface runoff is rapid, and the hazard of erosion is severe.

Most of the acreage is woodland. The existing stands consist mainly of upland hardwoods. The site is good to excellent for oak, hickory, yellow-poplar, and other upland hardwoods. Plant competition is moderate. The slope is a moderate to severe limitation on the use of equipment. The severe hazard of erosion must be considered if roads and trails are built.

Such trees as upland oaks, hickory, beech, black walnut, and dogwood furnish food and cover to many kinds of wildlife, including deer, wild turkey, and squirrels. (Capability unit VIIe-1)

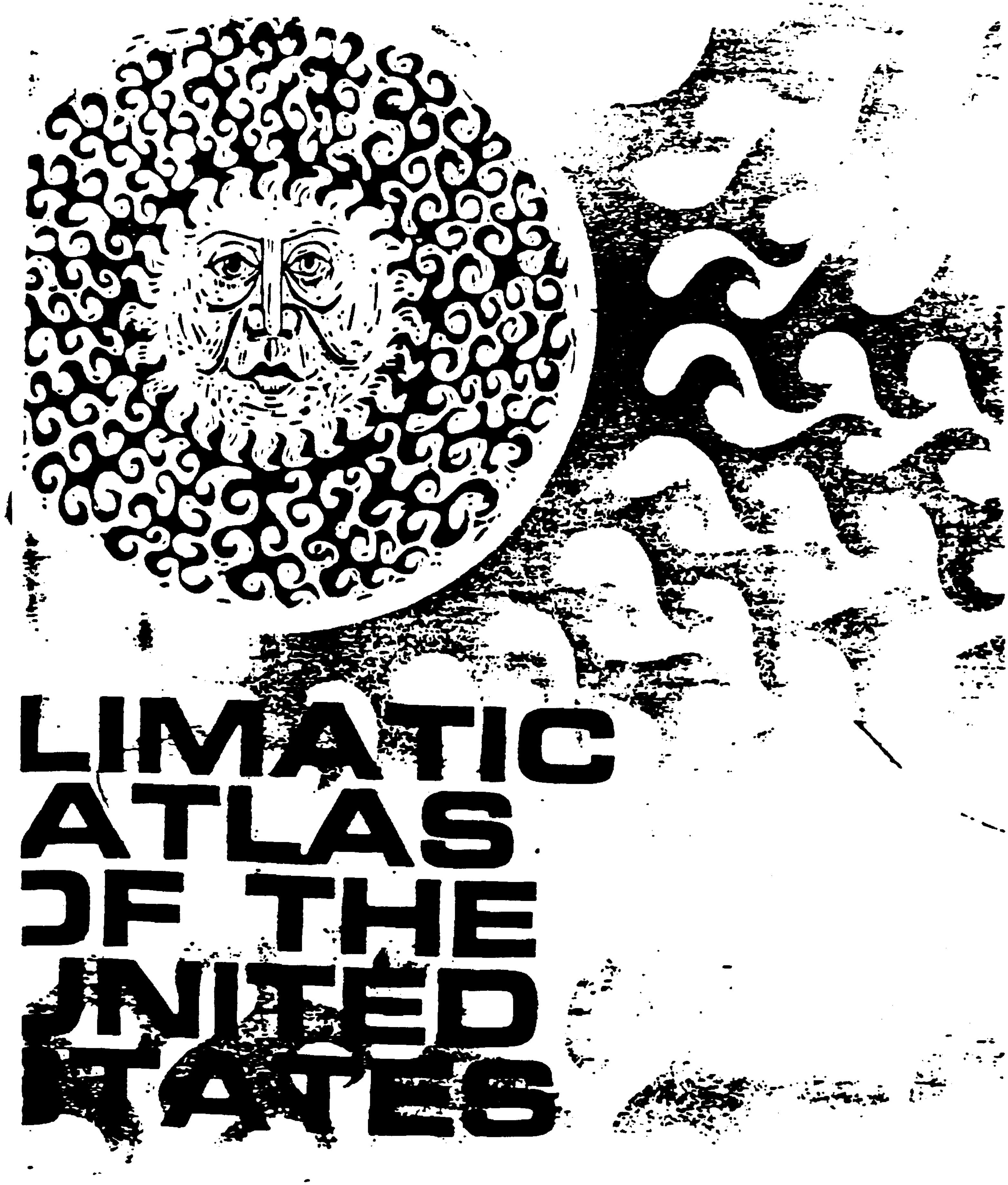
Robinsonville Series

This series consists of deep, well-drained, neutral to moderately alkaline, level soils on young natural levees along the Mississippi River. These soils formed in recent deposits of loamy sediment.

Representative profile of Robinsonville silt loam, three-fourths of a mile east of the Mississippi River and 50 yards south of the Tipton County line:

Ap—0 to 11 inches, dark grayish-brown (10YR 4/2) silt loam; weak, fine, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.

Reference 3



U.S. DEPARTMENT OF COMMI
C. R. Smith, Secretary

ENVIRONMENTAL SCIENCE SERVICES ADMI
Robert M. White, Administrator

ENVIRONMENTAL DATA SERVICE
Woodrow C. Jacobs, Director

JUNE 1968

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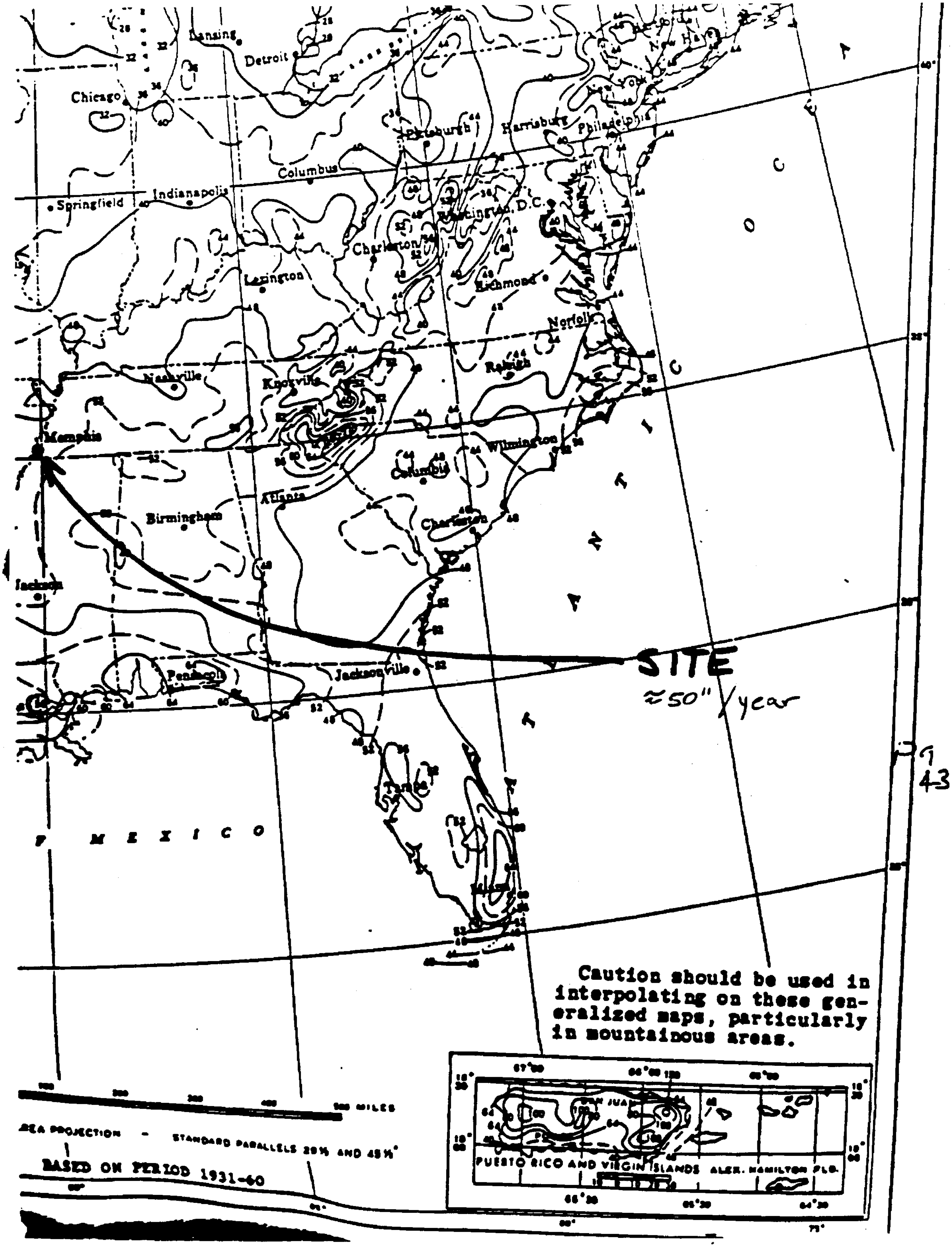
1983


Lansing
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Indianapolis
Washington, D.C.
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Lexington
Richmond
Norfolk
Nashville
Knoxville
Raleigh
Memphis
Wilmington
Columbia
Atlanta
Birmingham
Charleston
Jackson
Pensacola
Jacksonville
Tampa
Miami
MEXICO
ATLANTIC OCEAN
SITE
≈50"/year
pg 43
Caution should be used in interpolating on these generalized maps, particularly in mountainous areas.
MILES
AREA PROJECTION - STANDARD PARALLELS 29½ AND 45½°
BASED ON PERIOD 1931-60
PUERTO RICO AND VIRGIN ISLANDS
SAN JUAN
ALEX. HAMILTON FLD.

.AKE EVAPORATION

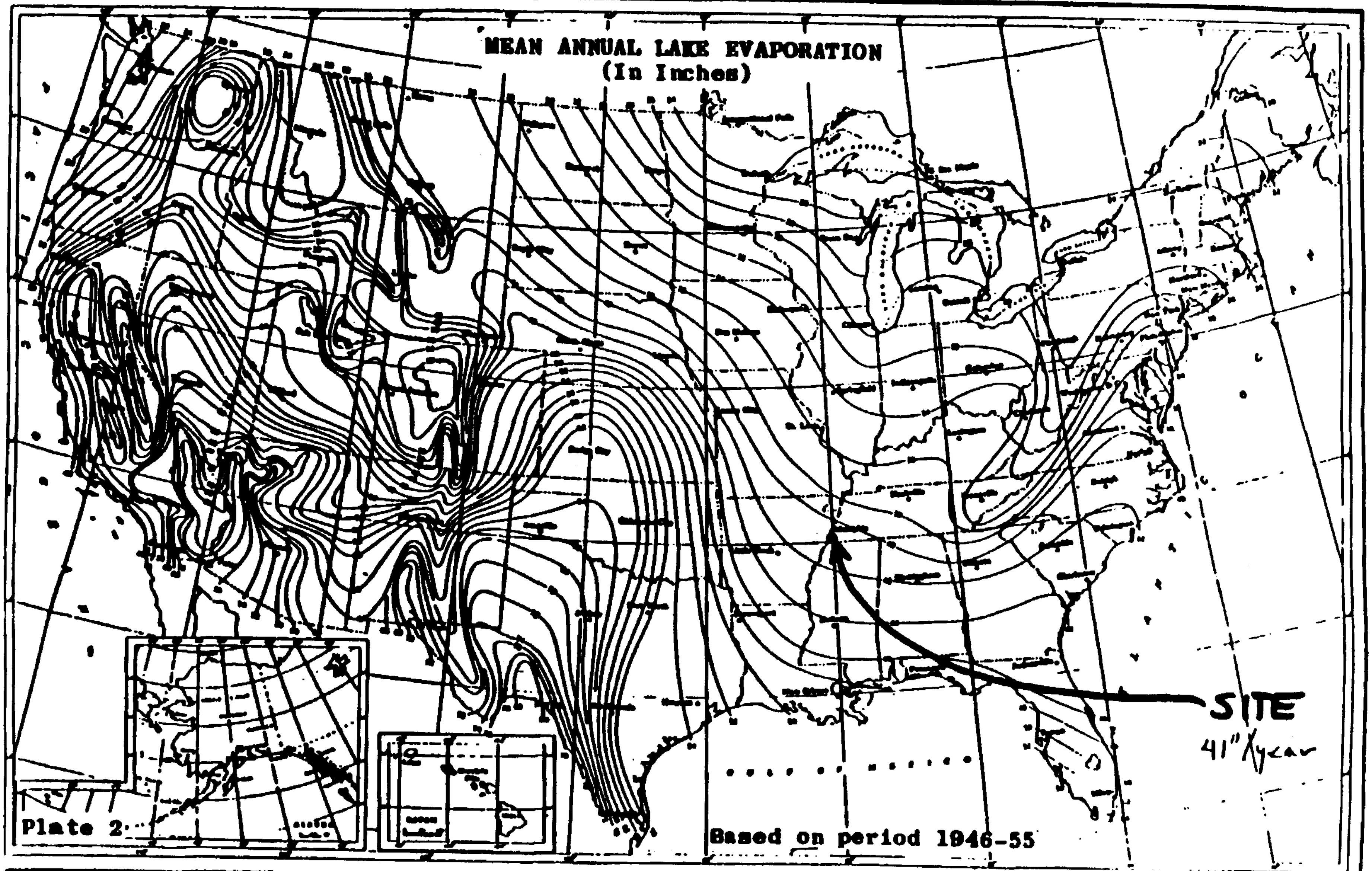
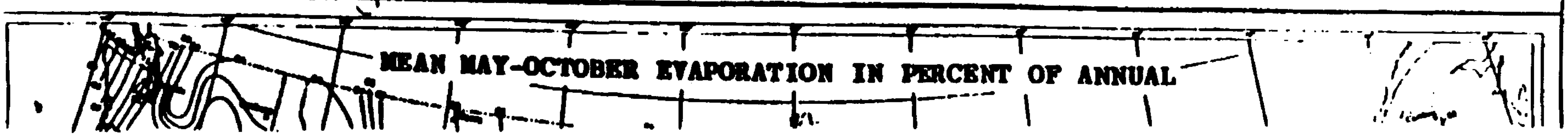


Plate 2



63

PB87-101580

Reference 4

United States
Department of
Agriculture

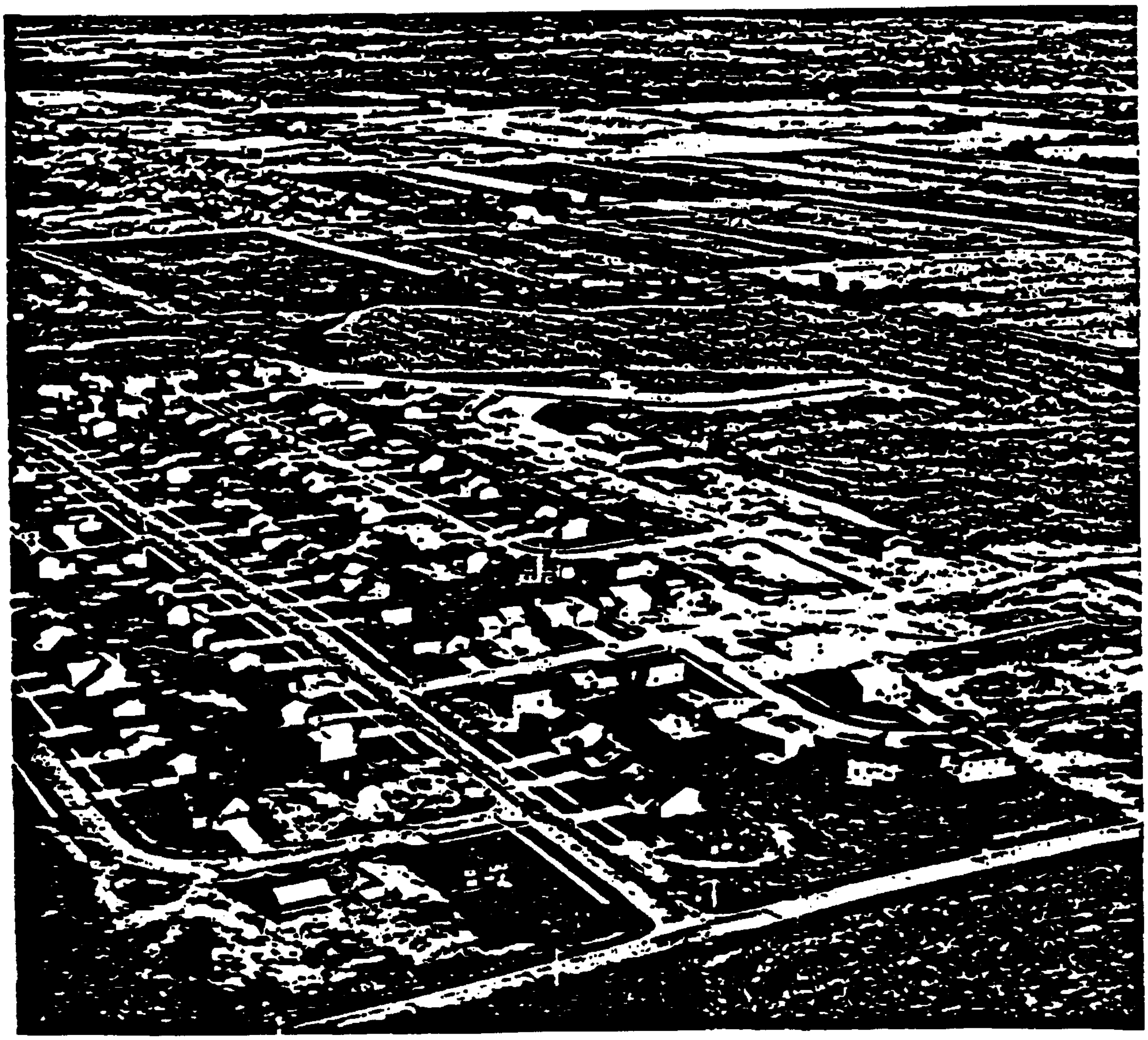
Soil
Conservation
Service

Engineering
Division

Technical
Release 55

June 1986

Urban Hydrology for Small Watersheds



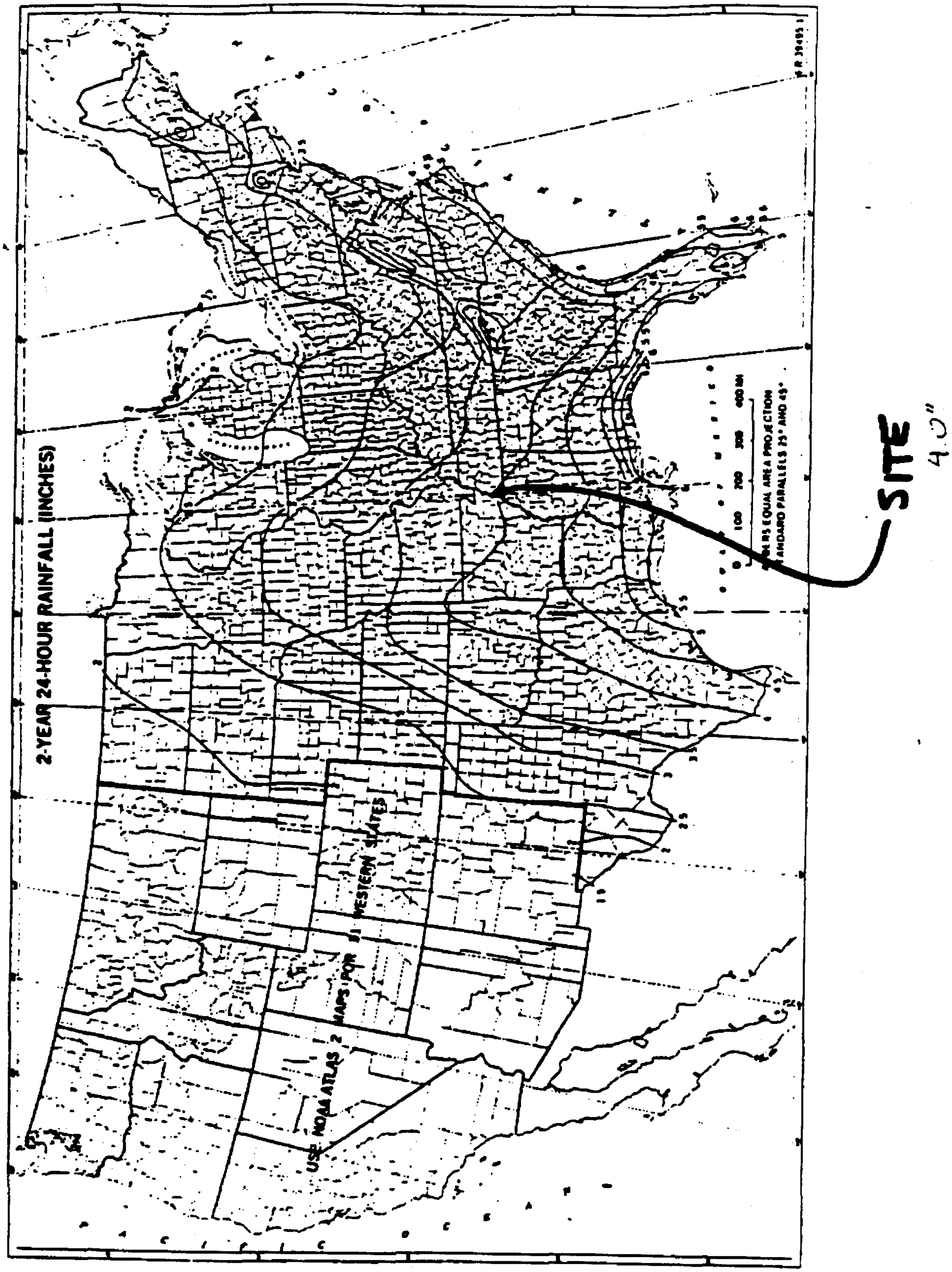


Figure II-3.—Two-year, 24-hour rainfall.

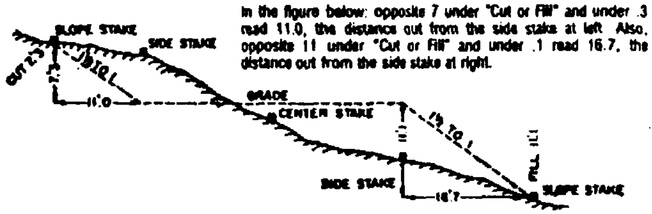
OVERSIZED

DOCUMENT

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

Roadway of any Width. Side Slopes 1½ to 1.

In the figure below: opposite 7 under "Cut or Fill" and under .3 read 11.0, the distance out from the side stake at left. Also, opposite 11 under "Cut or Fill" and under .1 read 16.7, the distance out from the side stake at right.



Cut or Fill	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
	Distance out from Side or Shoulder Stake										
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	4
5	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	5
6	9.0	9.2	9.3	9.5	9.6	9.8	9.9	10.1	10.2	10.4	6
7	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	7
8	12.0	12.2	12.3	12.5	12.6	12.8	12.9	13.1	13.2	13.4	8
9	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.6	14.7	14.9	9
10	15.0	15.2	15.3	15.5	15.6	15.8	15.9	16.1	16.2	16.4	10
11	16.5	16.7	16.8	17.0	17.1	17.3	17.4	17.6	17.7	17.9	11
12	18.0	18.2	18.3	18.5	18.6	18.8	18.9	19.1	19.2	19.4	12
13	19.5	19.7	19.8	20.0	20.1	20.3	20.4	20.6	20.7	20.9	13
14	21.0	21.2	21.3	21.5	21.6	21.8	21.9	22.1	22.2	22.4	14
15	22.5	22.7	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.9	15
16	24.0	24.2	24.3	24.5	24.6	24.8	24.9	25.1	25.2	25.4	16
17	25.5	25.7	25.8	26.0	26.1	26.3	26.4	26.6	26.7	26.9	17
18	27.0	27.2	27.3	27.5	27.6	27.8	27.9	28.1	28.2	28.4	18
19	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	29.9	19
20	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.4	20
21	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.6	32.7	32.9	21
22	33.0	33.2	33.3	33.5	33.6	33.8	33.9	34.1	34.2	34.4	22
23	34.5	34.7	34.8	35.0	35.1	35.3	35.4	35.6	35.7	35.9	23
24	36.0	36.2	36.3	36.5	36.6	36.8	36.9	37.1	37.2	37.4	24
25	37.5	37.7	37.8	38.0	38.1	38.3	38.4	38.6	38.7	38.9	25
26	39.0	39.2	39.3	39.5	39.6	39.8	39.9	40.1	40.2	40.4	26
27	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6	41.7	41.9	27
28	42.0	42.2	42.3	42.5	42.6	42.8	42.9	43.1	43.2	43.[illegible]	28
29	43.5	43.7	43.8	44.0	44.1	44.3	44.4	44.6	44.7	44.9	29
30	45.0	45.2	45.3	45.5	45.6	45.8	45.9	46.1	46.2	46.4	30
31	46.5	46.7	46.8	47.0	47.1	47.3	47.4	47.6	47.7	47.9	31
32	48.0	48.2	48.3	48.5	48.6	48.8	48.9	49.1	49.2	49.4	32
33	49.5	49.7	49.8	50.0	50.1	50.3	50.4	50.6	50.7	50.9	33
34	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.2	52.4	34
35	52.5	52.7	52.8	53.0	53.1	53.3	53.4	53.6	53.7	53.9	35
36	54.0	54.2	54.3	54.5	54.6	54.8	54.9	55.1	55.2	55.4	36
37	55.5	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	37
38	57.0	57.2	57.3	57.5	57.6	57.8	57.9	58.1	58.2	58.4	38
39	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.6	59.7	59.9	39
40	60.0	60.2	60.3	60.5	60.6	60.8	60.9	61.1	61.2	61.4	40

International Harvester

The paper in this book is made of 50% high grade rag stock with a WATER RESISTING surface sizing.

Reference 6

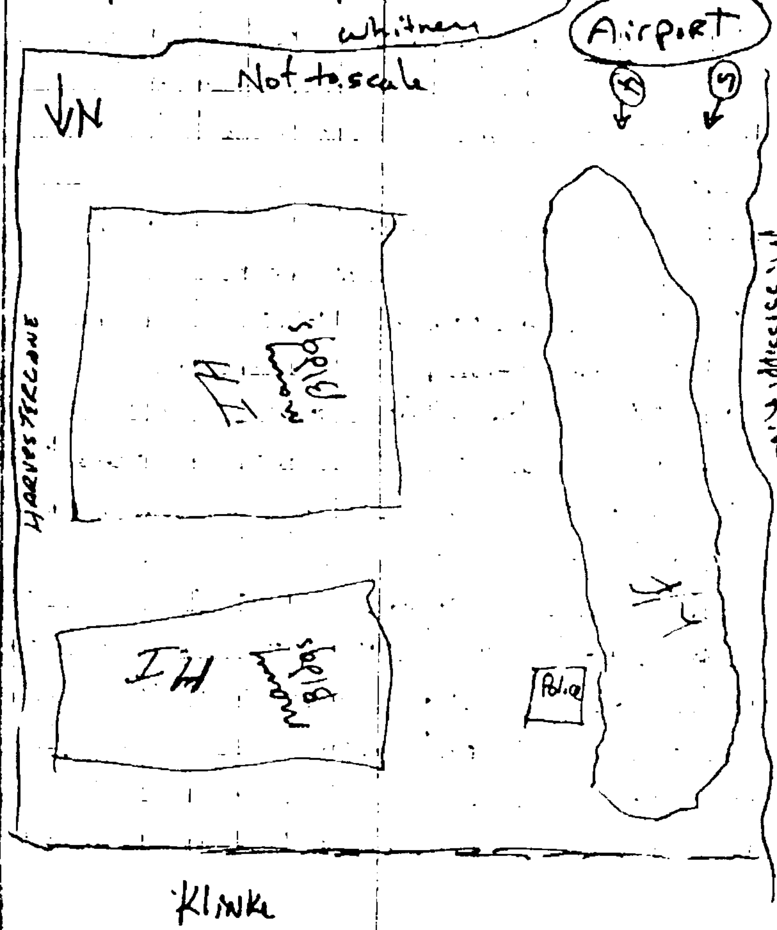
CONTENTS

PAGE NO.	REFERENCE	DATE

Robert G. Martel 07/27/93

0815 arrived at 3003 Harvester Lane; Sunny, Hot 85°; going to 100°. The property is now occupied by MASTERCRAFT, a division of Rachels, Inc. (901) 353-8100; also occupied by Center city Float ~~Company~~ Factory, and Memphis in May Whse, and the Memphis Police Impound lot.

whitney



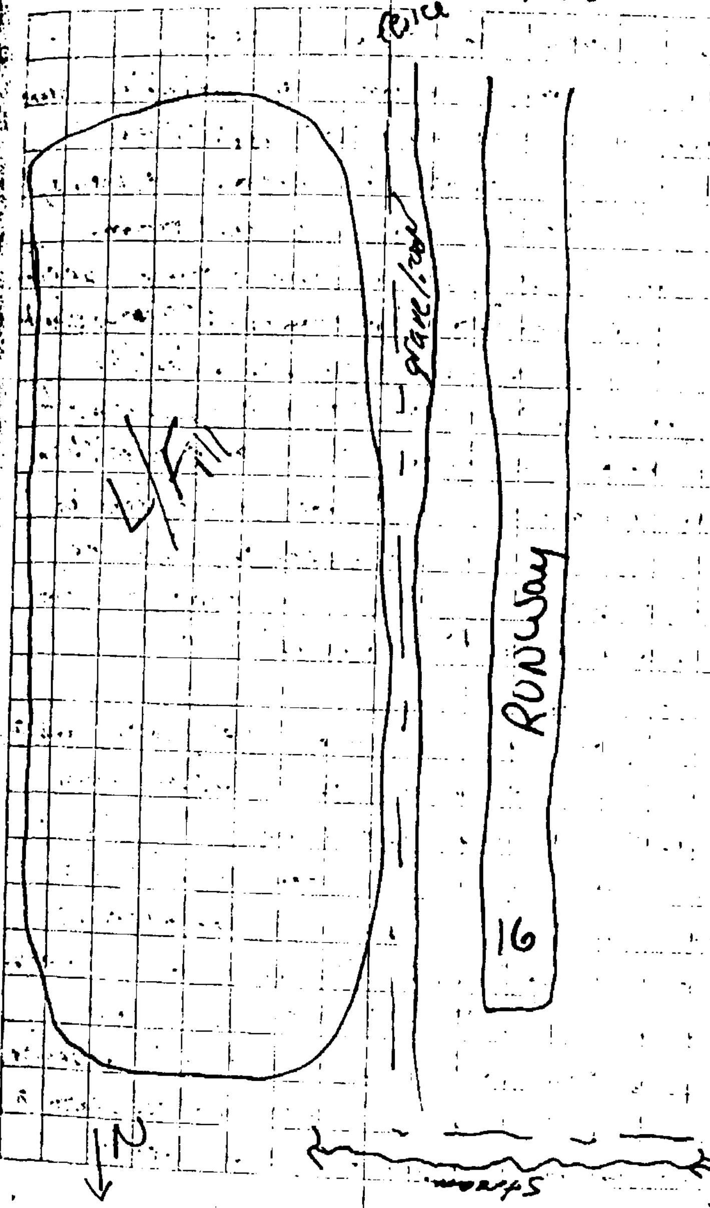
Robert C. Martel 07/27/93

1000 Spoke with Joe Taylor at the Memphis Waste Water Treatment facility, which is located SE of the ~~IH~~ RCM 07/27/93 IH site. He was not sure where the IH landfill is, but he showed me where his facilities Sludge ponds are. they are located along the river. He also showed me an ~~aer~~ RCM 07/27/93 ~~aire~~ RCM 07/27/93 airial photograph from Feb. 20, 1990 which includes the IH facility. He gave me a photocopy of it which helped locate the landfill.

1020 Photo #3 taken from WWTP admin. Bldg.

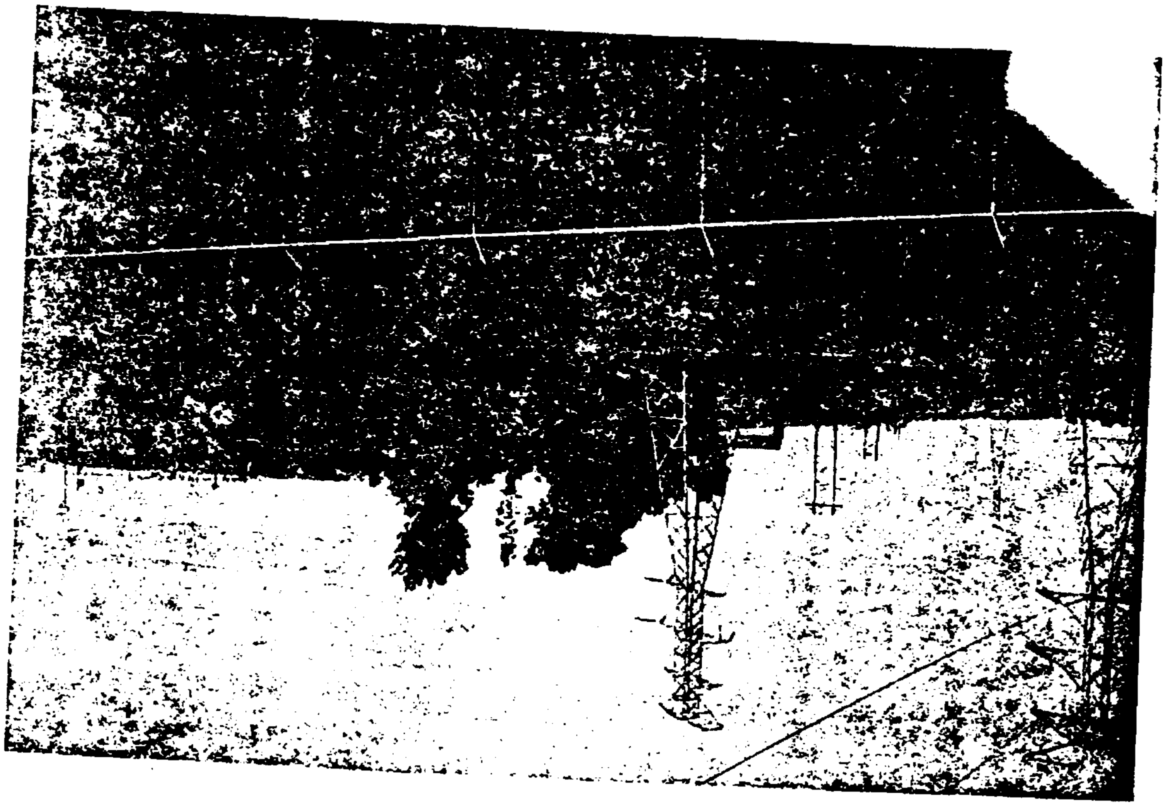
1045 gained access to airport area. Photos 5, 6, 7, 8 taken near intersection of gravel road, behind hangers. Possibly see MW #7, (yellow with red Awning. Photo #9 was taken from where the grave road makes a 90° turn near the runway, also photo #10 from the middle of the turn. Photos #11, 12 taken from just past the corner. Photos 13, 14, 15, 16 were taken from the gravel road approx. near the runway #16, near the Numbers themselves. Photos 17, 18, 19, and 20 were taken on the gravel road, even with the end of the runway. There seems to be no stressed vegetation and wildlife appears abundant

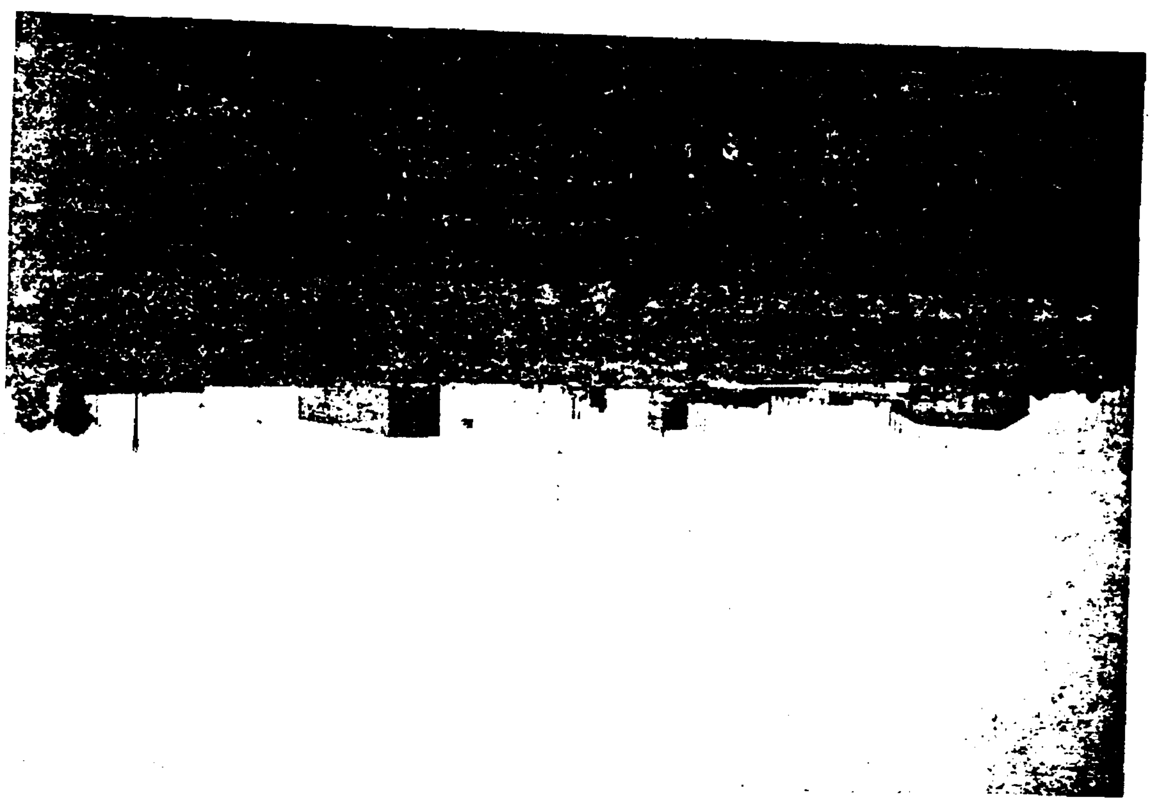
Robert C. Martel 07/27/93



Mi 1561.5-1001 River

RCM 07/27/93





Robert G. Martel 07/27/93

~~1120 Left airport field.~~ RGM 07/27/93

There is a small stream that probably flows from the site to the Mississippi River. I could not get access to this area. The runoff from the site likely goes into this stream. The landfill is grassy and mowed - seems well maintained from that ~~stand for~~ RGM 07/27/93 stand point. There is a fence that separates the airport from the site. ~~There is an area of direct access to the landfill~~ RGM 07/27/93 There is an area along N. 2nd street where there is no fence; also there is a section of fence at the corner of Whitney + N Second St that is open and not ~~gat~~ RGM 07/27/93 guarded.

1120 Left airport field.

1135 Arrive on Klinke ave. area. Took photos 21 and 22 and 23. Took photo 24 of front of facility from corner of Klinke and Harvester lane. Also 25, 26. There is another company occupying the site in addition to previously mentioned ones: Hi-speed Hoist and Crane Co. RGM 07/27/93 Inc @ 3015 Harvester lane; Phone 901-357-6231. One more company - Farnsworth Armored @ 3045 Harvester

1150 Took photo 27 from 2nd street → Took photo 28 of open gate mentioned earlier to show access.

1155 Left area.

Robert G. Martel

Reference 7

Potential Hazardous Waste Site

PRELIMINARY ASSESSMENT

INTERNATIONAL HARVESTER

MEMPHIS, SHELBY COUNTY, TENNESSEE

TND 007 02 4516

PRELIMINARY ASSESSMENT
INTERNATIONAL HARVESTER
TND 007 02 4516

I. HISTORY OF SITE

The International Harvester Company is located in Memphis, Tennessee, Shelby County approximately one-half mile from the Mississippi. The land in the area is mainly flat with some gently sloped hills.

This company manufactures farm equipment and the manufacturing process includes: casting shearing, machine, welding, assembly, washing, plating and painting.

International Harvester has been in operation since 1947. The company has been operating a disposal site on company property, adjacent to its manufacturing operation from the early 1940's to November 1983. At present the disposal site has been inactive four years, yet closure has not been documented or made available to state superfund file.

II. NATURE OF HAZARDOUS MATERIALS

According to the feasibility study of industrial waste fill site, a hazardous waste site investigation conducted by E.P.A. on October 20-21, 1980, at the International Harvester disposal site noted detectable quantities of lead, chromium and P.C.B's. chromium levels in water samples taken at the site noted the drinking water standards for chromium limits its concentration to 0.05 mg/l. lead levels in water samples taken showed the concentration to be less than 0.04 mg. which is less than the DWS limits of 0.05 mg/l.

Soil and sediments samples taken at the site also indicate detectable levels of lead, chromium, and PCB's. Samples taken at five locations showed a chromium concentration range 30 to 278 mg/kg and a lead concentration ranging from 57 to 468 mg/kg. PCB's were detected in all soil and sediment samples with concentrations ranging from 180 ug/kg to 18,000 ug/kg quantity of hazardous waste is unknown at this time. International Harvester's landfill is located in a flood plain.

III. DESCRIPTION OF HAZARDOUS CONDITION, INCIDENTS, PERMIT VIOLATION

There is unstable containment due to the fact that the Landfill is located in a floodplain, and therefore requires protection from possible floodwaters.

IV. ROUTE'S FOR CONTAMINATION

Drainage ditches on site empty toward the Mississippi River.

The landfill lies in the flood plains of the Mississippi River and is not protected from possible flood waters.

The site drains also into fields that grow soybeans and wheat.

V. POSSIBLE AFFECTED POPULATION AND RESOURCES

There is a potential for surface water contamination due to possible floodwaters, possible groundwater contamination due to the aquifer of concern and possible food contaminations.

Approximately 2000,00 populus could be affected.

VI. RECOMMENDATION AND JUSTIFICATIONS

This site has become inactive as of November 1983. It is considered to be a RCRA facility. It should be noted for the DSWM that there exist the potential for existing irregularities in waste distribution and a determination of the potential harm of the hazardous waste alleged to be present should be looked into.

RCRA ASSESSMENT

In State Superfund estimation this site (International Harvester) is a RCRA facility.

Since the landfill was in full operation, storing hazardous waste over the alloted time and was considered an active site up until 1983.

The State Superfund Program has conducted remedial action, but at this time International Harvester is considered a RCRA facility and no further action will be taken on behalf of Site Investigation, Division of Superfund.

TH/lag SF #5

REFERENCES

1. Tennessee Department of Health and Environment State Superfund file # 79-525(1).

2. Tennessee Department of Health and Environment Solid Waste Management file # 79-525.

3. Feasibility study of industrial waste fill site. Prepared by: Environmental Management Planning & Engineering March 1982.

4. Tennessee Department of Health and Environment Division of Solid Waste Management Commissioners Orders.

5. Topographic Map of Northwest Memphis Quadrangle.

INTERNATIONAL HARVESTER
3003 HARVESTER AVENUE
MEMPHIS, TENNESSEE

I. Site Identification

A. Name - International Harvester
B. County - Shelby
C. Nearest Urban Area - Memphis
D. Water Supplies Potentially Affected

1. Public - Not affected
2. Private - Not affected
3. Other

a) Drainage ditches on site empty towards the Mississippi River

b) The landfill lies in the floodplains of the Mississippi River and is not protected from possible floodwaters.

c) The site also drains into fields that grow soybeans and wheat.

E. Acreage - 10 acres

II. Site History

A. Owner - International Harvester Corp.
B. Operator - International Harvester Corp., G. W. Beadles, Manager
C. Hazardous Waste Data

1. Source - International Harvester
2. Volume - approximately 1000-2000 tons
3. Types of Wastes - Wood, paper, foundry sand, glass, metal scraps, cardboard, trash, paint and paint sludge, washing machine sludge, oils, greases, coolants, wastewater treatment sludge, spent transformer oil, varnish, sealing compound, caustics and acids, electroplating treatment sludge and miscellaneous industrial solid waste

D. Period of Operation - 1947 to present

E. Current Status - Feasibility study for closure submitted to SWM Superfund.

III. Investigations

A. Sampling Data

On October 20-21, 1980, EPA conducted a hazardous waste site investigation. During this investigation five sediment or soil samples and two water samples were collected. Chromium and lead were below or slighly above drinking water limits in water, but were very high in sediment/soil; high levels of PCBs were found in all soil samples, and

moderate to low amounts of some extractable/purgeable organic compounds were also found in soil/sediment samples.

Although chromium and lead contamination may enter the Mississippi River, the flow of this river, 470,000 cu. ft/sec., is enough to dilute it. The metal, PCB and organic-contaminated soil may, however, be washed into adjacent fields, which grow food crops, and may also migrate in the event of flooding.

B. Other Investigating Work - None

C. Costs Incurred

Entity	Activity	Cost
EPA	Site Investigation	$15,000

IV. Enforcement Action

1. TN

September 1, 1981 - (SWM & EPA) International Harvester informed that their landfill was out of compliance with the floodplain criteria and was on the EPA open dump inventory.

September 17, 1981 - March 17, 1982 - Extension granted for submittal of a feasibility study for correcting the floodplain problem. Feasibility study submitted March 17, 1982. International Harvester accepted recommendation to close the landfills but subsequently developed financial problems. SWM allowed sufficient time for them to recover financially before requiring closure.

May 6, 1983 (SWM) - Hazardous Waste inspection found no violations for hazardous waste generators.

November, 1983 SWM Superfund staff reviewed closure plan and developed recommendations.

2. EPA

October 20, 1980 - Conducted a hazardous waste site inspection.

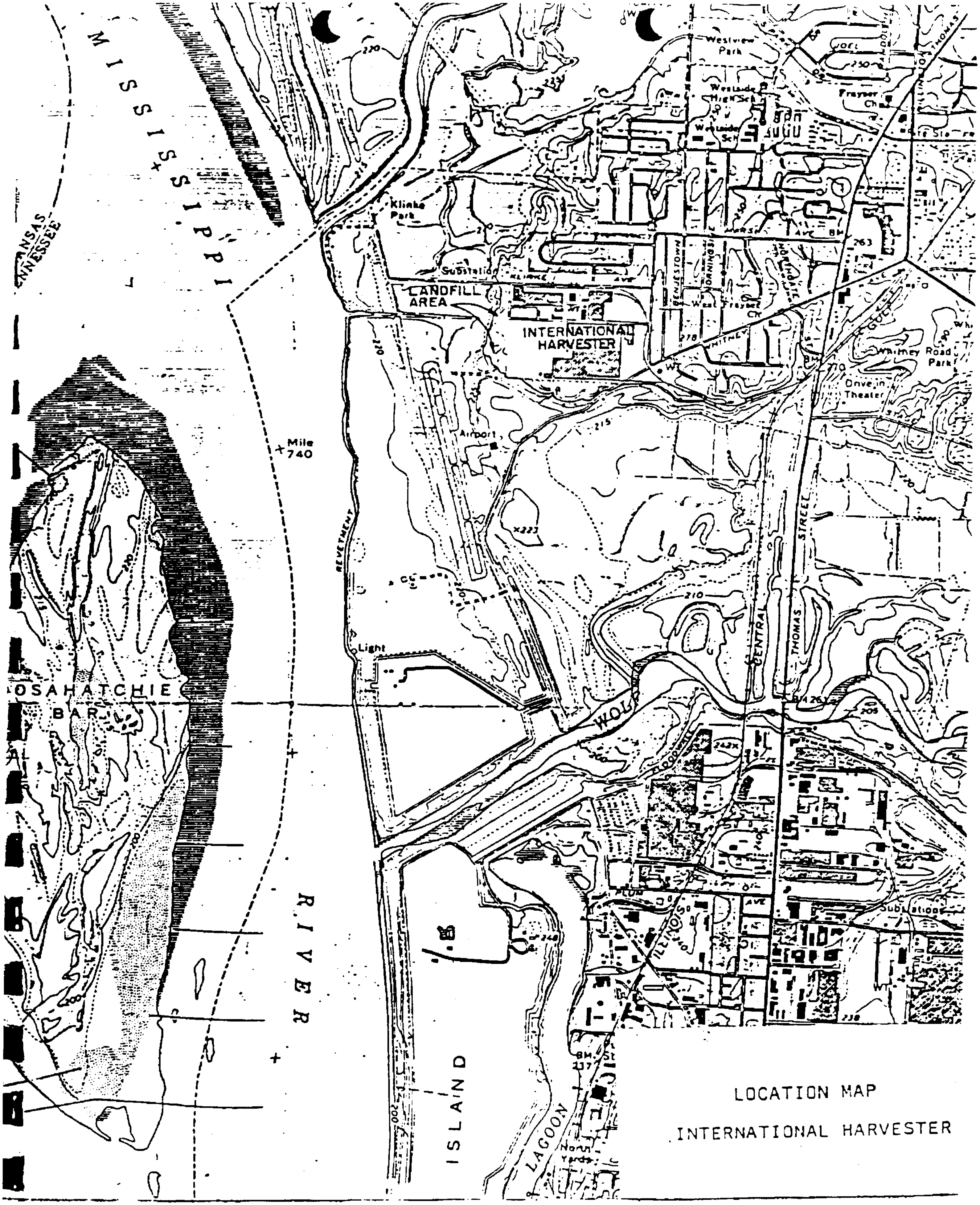
October 23, 1981 - International Harvester informed of potential violations of RCRA.

3. Local - None

V. Remedial Action

Entity	Activity	Cost

None to date



LOCATION MAP

INTERNATIONAL HARVESTER

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION
01 STATE | 02 SITE NUMBER
TN | D 007-02-4516

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site): International Harvester Company EPIC #73	02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER: 3003 Harvester Lane

03 CITY	04 STATE	05 ZIP CODE	06 COUNTY	07 COUNTY CODE	08 CONG DIST
Memphis	TN	38127	Shelby	157	8

09 COORDINATES LATITUDE 35 12 23. LONGITUDE 90 03 05.

10 DIRECTIONS TO SITE (Starting from nearest public road)
I-240 west until road forks, go north on Thomas, to Marsch, turn west on Marsch to Sunrise North to Frayer then west to Harvester.

III. RESPONSIBLE PARTIES

01 OWNER (If known)	02 STREET (Business, mailing, residential)
International Harvester Corporation	3003 Harvester Lane

03 CITY	04 STATE	05 ZIP CODE	06 TELEPHONE NUMBER
Memphis	TN	38127	(901) 357-5311

07 OPERATOR (If known and different from owner)	08 STREET (Business, mailing, residential)
International Harvester Corporation	3003 Harvester Lane

09 CITY	10 STATE	11 ZIP CODE	12 TELEPHONE NUMBER
Memphis	TN	38127	(901) 357-5311

13 TYPE OF OWNERSHIP (Check one)
☒ A. PRIVATE ☐ B. FEDERAL: ____ (Agency name) ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL
☐ F. OTHER: ____ (Specify) ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)
☐ A. RCRA 3001 DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☒ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION
☒ YES DATE 10/20/80 (MONTH DAY YEAR)
☐ NO

BY (Check all that apply)
☒ A. EPA ☐ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR
☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: ____ (Specify)
CONTRACTOR NAME(S): ____

02 SITE STATUS (Check one)
☐ A. ACTIVE ☐ B. INACTIVE ☒ C. UNKNOWN

03 YEARS OF OPERATION
1947 (BEGINNING YEAR) | 1983 (ENDING YEAR) ☐ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED
Alleged chromium and lead, PCB's and some extractable/purgeable organic compounds.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION
Drainage ditches on site that empty toward the Mississippi River. The landfill lies in the flood plains of the Mississippi River and is not protected from possible flood water.

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)
☐ A. HIGH (Inspection required promptly) ☒ B. MEDIUM (Inspection required) ☐ C. LOW (Inspect on time available basis) ☐ D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT	02 OF (Agency/Organization)	03 TELEPHONE NUMBER
Z.S. Migut	International Harvester	(901) 357-531

04 PERSON RESPONSIBLE FOR ASSESSMENT	05 AGENCY	06 ORGANIZATION	07 TELEPHONE NUMBER	08 DATE
Robin Tanya Humphries	TDH&E	Superfund	(615) 741-3424	05 13 87 (MONTH DAY YEAR)

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

I. IDENTIFICATION

01 STATE | 02 SITE NUMBER
TN | D 007-02-4516

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply)

- [x] A. SOLID
- [ ] B. POWDER, FINES
- [x] C. SLUDGE
- [ ] D. OTHER ________ (Specify)
- [ ] E. SLURRY
- [ ] F. LIQUID
- [ ] G. GAS

02 WASTE QUANTITY AT SITE (Measures of waste quantities must be independent)

TONS ________

CUBIC YARDS ________

NO. OF DRUMS ________

03 WASTE CHARACTERISTICS (Check all that apply)

- [x] A. TOXIC
- [ ] B. CORROSIVE
- [ ] C. RADIOACTIVE
- [ ] D. PERSISTENT
- [ ] E. SOLUBLE
- [ ] F. INFECTIOUS
- [ ] G. FLAMMABLE
- [ ] H. IGNITABLE
- [ ] I. HIGHLY VOLATILE
- [ ] J. EXPLOSIVE
- [ ] K. REACTIVE
- [ ] L. INCOMPATIBLE
- [ ] M. NOT APPLICABLE

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE	6000.00	KG	
OLW	OILY WASTE	unknown		
SOL	SOLVENTS			
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
D007	Chromium	7446.47.3	Unknown		
D008	Lead	1335257			

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

TDHE, Superfund File

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
TN	D 007-02-4516

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 [X] A. GROUNDWATER CONTAMINATION
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [X] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00
04 NARRATIVE DESCRIPTION

Due to the variations of the Memphis sands, this aquifer has a possibility for ground water contamination.

01 [X] B. SURFACE WATER CONTAMINATION
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [X] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00
04 NARRATIVE DESCRIPTION

The landfill lies in the flood plains of the Mississippi River and is not protected from possible flood waters.

01 [ ] C. CONTAMINATION OF AIR
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [ ] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ______
04 NARRATIVE DESCRIPTION

01 [ ] D. FIRE/EXPLOSIVE CONDITIONS
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [ ] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ______
04 NARRATIVE DESCRIPTION

01 [X] E. DIRECT CONTACT
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [X] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00
04 NARRATIVE DESCRIPTION

Possible drinking water contamination.

01 [X] F. CONTAMINATION OF SOIL
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [X] ALLEGED
03 AREA POTENTIALLY AFFECTED: 10 acres (acres)
04 NARRATIVE DESCRIPTION

Possible contamination of soil.

01 [X] G. DRINKING WATER CONTAMINATION
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [X] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00
04 NARRATIVE DESCRIPTION

Alleged chromium and lead were below or slightly above drinking water limits.

01 [ ] H. WORKER EXPOSURE/INJURY
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [ ] ALLEGED
03 WORKERS POTENTIALLY AFFECTED: ______
04 NARRATIVE DESCRIPTION

01 [ ] I. POPULATION EXPOSURE/INJURY
02 [ ] OBSERVED (DATE: ______) [ ] POTENTIAL [ ] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ______
04 NARRATIVE DESCRIPTION

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION
01 STATE: TN | 02 SITE NUMBER: D 007-02-516

II. HAZARDOUS CONDITIONS AND INCIDENTS (Continued)

01 ☐ J. DAMAGE TO FLORA — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ K. DAMAGE TO FAUNA — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION (include name(s) of species)

01 ☒ L. CONTAMINATION OF FOOD CHAIN — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☒ ALLEGED
04 NARRATIVE DESCRIPTION

Site drains into fields tht grow soybeans and wheat.

01 ☒ M. UNSTABLE CONTAINMENT OF WASTES — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☒ ALLEGED
(Spills/runoff/standing liquids/leaking drums)
03 POPULATION POTENTIALLY AFFECTED: 2000.00 — 04 NARRATIVE DESCRIPTION

Landfill is out of compliance with the flood plain criteria.

01 ☐ N. DAMAGE TO OFFSITE PROPERTY — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ P. ILLEGAL/UNAUTHORIZED DUMPING — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL OR ALLEGED HAZARDS

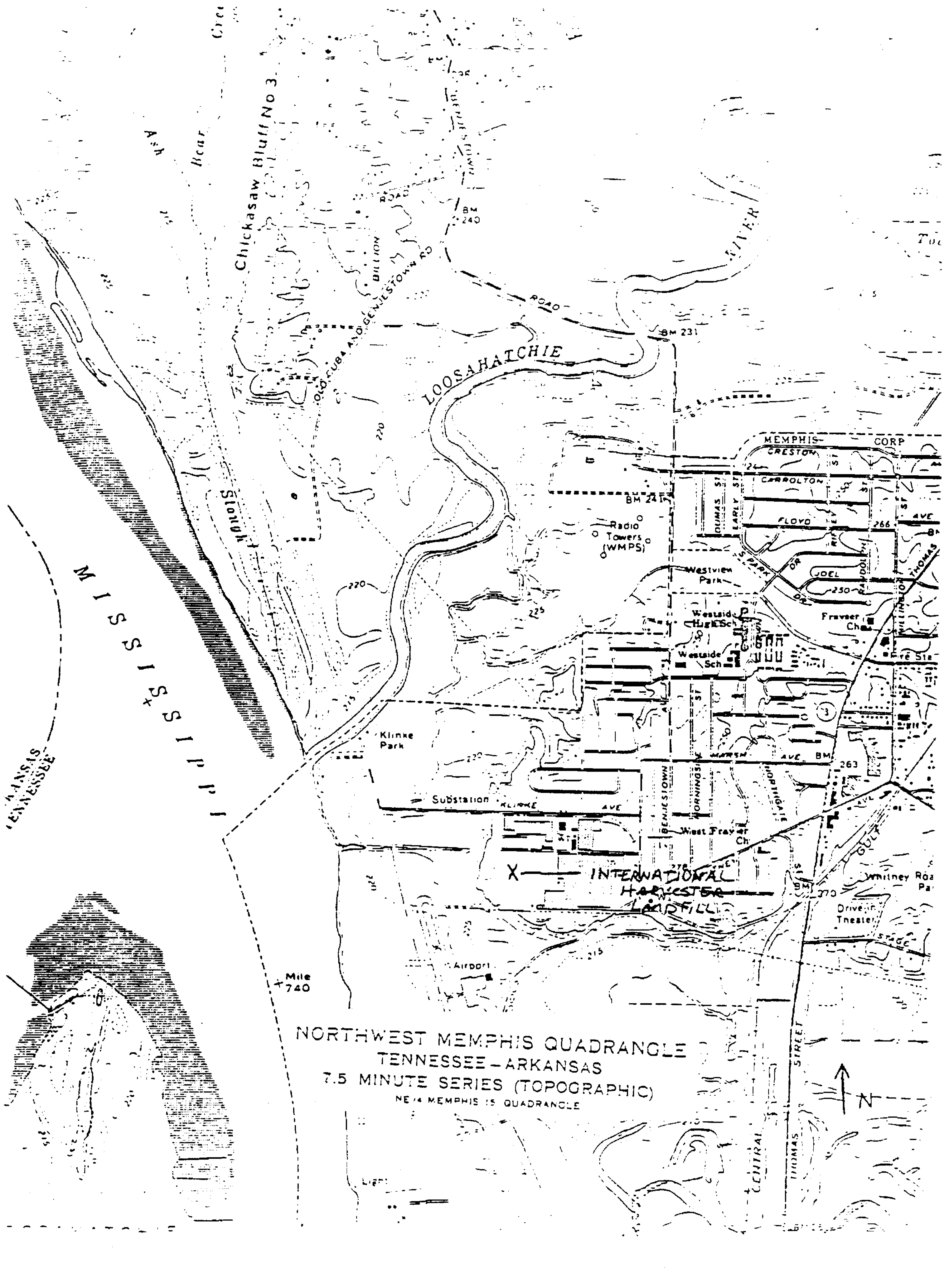
Chromium, lead, PCB's, other organic waste.

III. TOTAL POPULATION POTENTIALLY AFFECTED: ______

IV. COMMENTS

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

TDHE Superfund File
Feasibility study of industrial waste fill site prepared for International Harvester Co. by Environmental Management Planning and Engineering.



NORTHWEST MEMPHIS QUADRANGLE
TENNESSEE-ARKANSAS
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 MEMPHIS 15 QUADRANGLE
MISSISSIPPI
ARKANSAS
TENNESSEE
LOOSAHATCHIE
RIVER
Chickasaw Bluff No 3
Slough
Bear
Ash
ROAD
BM 240
BM 231
BM 241
OLD CUBA AND GENJESTOWN RD
DILLION
MEMPHIS CORP
CRESTON
CARROLTON
FLOYD
JOEL
RANDOLPH
THOMAS
DUMAS ST
EARLY ST
Radio Towers (WMPS)
Westview Park
Westside High Sch
Westside Sch
Frayser Ch
Klinke Park
Substation
KLINKE AVE
MARSH AVE
BM 263
GENJESTOWN
MORNINGSIDE
West Frayser Ch
X
INTERNATIONAL HARVESTER LANDFILL
BM 270
Whitney Road
Drive-in Theater
Airport
Mile 740
CENTRAL
THOMAS
STREET
Light
N
220
225
215
250
266

Reference 8

[illegible]

March 1[illegible], 19[illegible]

Internationa[illegible] Harve[illegible] Co[illegible],
c/o C. T. Corporat[illegible]
530 [illegible] Stre[illegible]
Knoxville, T[illegible]ssee 3[illegible]02

Dear Sir:

Enclose[illegible] please [illegible] a [illegible] document [illegible] Commissioner's Order [illegible] by James E. Wol[illegible] against International [illegible] Company. [illegible] particul[illegible] direct your attention [illegible] Notice of [illegible].

If you have any questions please cal[illegible].

Sincerely,

William [illegible]. Penny
Assistan[illegible] General Counsel

Enclosure

cc: Don Shackelford [illegible]
Tom Blankenship, Jr.
Jean Inman

STATE OF TENNESSEE
DEPARTMENT OF HEALTH AND ENVIRONMENT

IN THE MATTER OF:	)	
	)	
THE INTERNATIONAL HARVESTER COMPANY MEMPHIS, TENNESSEE	)	DIVISION OF SOLID WASTE MANAGEMENT NO. 84-156
	)	
RESPONDENT	)	

COMMISSIONER'S ORDER

Comes now, James E. Word, Commissioner of the Tennessee Department of Health and Environment, and states that:

PARTIES

I.

James E. Word is the duly appointed Commissioner of the Tennessee Department of Health and Environment (the "Department").

II.

The International Harvester Company (the "Respondent") is a Maryland Corporation qualified to do business in Tennessee. It is doing business at 3003 Harvester Lane, Memphis, Tennessee 38127. Its registered agent for service of process is: C. T. Corporation Systems, 530 Gay Street, Knoxville, Tennessee 37902. The Company manufactures farm equipment and the manufacturing processes include casting, shearing, machining, welding, assembly, washing, plating and painting.

JURISDICTION

III.

Pursuant to T.C.A. Sections 68-46-111 and 68-46-206, the Commissioner is authorized to issue an order to any liable party requiring such party to investigate, identify, contain, and clean up, including monitoring and maintenance, inactive hazardous substance sites which pose or may pose a danger to public health, safety or the environment because of the release or threatened release of hazardous substances. Pursuant to T.C.A. Section 68-46-215 the Commissioner may issue an order for correction to the appropriate person, and this order shall be complied with within the time limit specified in the order.

IV.

Respondent is a "person" within the meaning of T.C.A. Section 68-46-104 and is also a "liable party" within the meaning of T.C.A. Section 68-46-202.

FACTS

V.

As part of the Respondents manufacturing process, it produces metal plating wastes containing lead, chromium and other elements. This liquid waste is a hazardous substance as defined in T.C.A. Section 68-46-202. The waste is also a listed hazardous waste as defined in the Tennessee Hazardous Waste Regulation 1200-1-11-.02(4).

VI.

The existence of this inactive hazardous substance site poses or may be reasonably anticipated to pose a danger to public health, safety, and environment. This inactive hazardous substance site appears on the proposed list of such sites (pursuant to T.C.A. Section 68-46-206) eligible for investigation, indentification, containment and clean up.

VII.

The Respondent reported that it has disposed of hazardous waste at a disposal site owned by International Harvester Company and located at latitude and longitude coordinates 35°12'23" and 90°03'05" respectively. The Respondent has reported the disposal of wood, paper, foundry sand, glass metal scraps, cardboard, trash, paint and paint sludge, washing machine sludge, oils, grease, coolants, wastewater treatment sludge, spent transformer oil, varnishes, sealing compounds, caustics and acids, electroplating treatment sludge and miscellaneous industrial solid waste. The disposal site has been inactive since at least November, 1983.

VIII.

On October 20-21, 1980 EPA conducted a hazardous waste site investigation of International Harvester. Analysis of samples taken during this inspection revealed that concentrations of chromium and lead were below or only slightly above drinking water limits in water, but were very high in sediment/soil. High levels of PCB's were found in all soil samples, and moderate to low amounts of some extractable/purgeable organic compounds were also found in soil/sediment samples.

CLAIMS FOR RELIEF

IX.

By operating this disposal site and generating the hazardous substances disposed of in the site, Respondent is a "liable party" as defined in T.C.A. Section 68-46-202 which is defined as:

"(a.) he owner or operator of an inactive hazardous substance site;

(b.) Any person who at the time of disposal was the owner or operator of an inactive hazardous substance site;

(c.) Any generator of hazardous substance who at the time of disposal caused such substance to be disposed of at an inactive hazardous substance site;. . ."

This site is a hazardous substance site within the meaning of T.C.A. Section 68-46-202 which is defined as "any site or area where hazardous substance disposal has occurred."

X.

PREMISES CONSIDERED, I, James E. Word, hereby ORDER the Respondent, International Harvester Company to comply with the following:

A. INITIAL ASSESSMENT

1. Within sixty (60) days of receipt of this Order, the Respondent shall submit to the Department any existing data available to the Respondent which is pertinent to the assessment of the hazard that the specified site may pose to public health and the environment. This information shall include available data listed in paragraph X.B.2 of this Order and shall be submitted in duplicate.

2. Following receipt of this information, the Department will schedule an initial assessment conference which the Respondent shall attend in the Nashville Office of the Department Division of Solid Waste Management. The Respondent shall be given seven (7 days notice prior to this meeting. The purpose of this conference will be to discuss existing data and determine the need for further investigation, remedial action and/or long term monitoring and maintenance. A schedule for future activities, deemed necessary by the Department, shall be established at this conference. Depending on existing data, the Department may determine that no further action is necessary. In all other cases, the schedule established in this conference will provide the dates by which the activities enumerated herein must be completed.

B. INVESTIGATION PROGRAM

1. According to the schedule established in the initial assessment conference, the Respondent shall submit to the Department a proposed Investigation Plan.

2. In order to provide an accurate assessment of the hazard posed by the site to public health and the environment and to develop design data for remedial action, the Investigation Plan shall include, but not be limited to, assessment of the following factors:

a. Types and quantities of hazardous substances disposed at the site.

b. Physical state, analytical summary, toxicological characteristics and other pertinent data defining hazardous substances present at the site.

c. Methods and extent of the disposal operation including containment methods used, plans and/or photographs of site operation, perimeter and depth of disposal area, and type of disposal operation conducted (open burning, trench, surface impoundment, etc.).

d. Observed release of contaminants to groundwater, surface water or air, including sampling, to determine contaminant concentrations and extent of contaminant migration.

e. Hydrogeologic evaluation to determine depth to groundwater, permeability of the unsaturated zone, distance to nearest surface water and slope of the disposal area and intervening terrain.

f. Population and environment potentially affected:

(1.) Groundwater use and population served by groundwater sources within a three (3) mile radius of the perimeter of contaminant migration.

(2.) Surface water use and population served within a three (3) mile reach downstream of the perimeter of contaminant migration.

(3.) Population potentially affected by contaminant releases to the air within a four (4) mile radius of the perimeter of contaminant migration.

(4.) Distance from the site to sensitive environments such as a natural wetland, critical habitat for an endangered species or a National Wildlife Refuge.

g. Fire and explosion hazard assessment of the site.

h. Direct contact hazard assessment of the site.

3. The Investigation Plan must include cost estimates and a proposed schedule for completion of activities involved in the investigation. Following a review of the Plan, the Department may schedule a meeting which Respondent shall attend to discuss any revisions required by the Department. The Respondent will be given seven (7) days notice prior to the meeting. On or before a deadline date established in this review meeting, a revised Investigation Plan shall be submitted by the Respondent to the Department. Upon approval by the Department of the revised Investigation Plan, the Respondent shall begin required activities according to the revised Investigation Plan.

C. REMEDIAL ACTION SELECTION AND IMPLEMENTATION

1. Following completion of the investigation activities, a report providing an assessment of the hazard posed by the site to public health and the environment and proposing remedial action alternatives shall be submitted by the Respondent to the Department according to the Investigation Plan schedule. This report will be referred to as a Hazard Assessment/Remedial Action report (herein after referred to as "HA/RA"). Remedial action alternatives must include cost estimates and proposed schedules for completion of activities involved in remedial action implementation.

2. Assessment of each remedial action alternative must include consideration of the following factors:

   a. The technological feasibility of each alternative;

   b. The cost-effectiveness of each alternative;

   c. The nature of the danger to the public health, safety, and the environment posed by the hazardous substances at the site; and

   d. The extent to which each alternative would achieve the goal of T.C.A. Section 68-46-206(d) which states, in part, ". . . The goal of any such action shall be cleanup and containment of the site through the elimination of the threat to public health, safety and the environment posed by the hazardous substance."

3. Following the Department review of the HA/RA Report, the Department will schedule a meeting which the Respondent shall attend, to discuss any revisions required by the Department. The Respondent shall be given seven (7) days notice prior to the meeting. On or before a deadline date established in this review meeting, a revised HA/RA Report shall be submitted to the Department. Upon receipt of approval by the Department of the revised HA/RA Report, the Respondent shall begin activities required by the revised HA/RA Report, unless the Department determines no further action is necessary.

4. The HA/RA activities shall not be considered complete until the Department has reviewed these activities and issued a letter of acceptance to the Respondent.

D. SITE MONITORING AND MAINTENANCE

1. Where the Department determines a need for site monitoring and maintenance, the Respondent shall provide a Site Monitoring and Maintenance Plan (herein after referred to as "M/M Plan") which shall include a proposed schedule for completion of required activities and cost estimates within ninety (90) days of receipt of a request for said Plan by the Department.

2. Within forty-five (45) days of receipt of this M/M Plan by the Department, the Respondent shall attend a meeting with the Department to discuss any required revisions. On or before a deadline established in this review meeting, a revised M/M Plan shall be submitted by the Respondent to the Department. Upon receipt of approval by the Department, the revised M/M Plan will go into effect.

E. To the extent practicable, any investigation, identification, containment and clean-up, including monitoring and maintenance, shall be consistent with the national contingency plan promulgated pursuant to Section 105 of Public Law 96-510.

F. Certain activities may be deemed critical by the Department and shall require observation by the Department. The Respondent shall provide sufficient notice to the Department to allow scheduling of personnel for these activities. The Department also reserves the right to observe any other activities required pursuant to this Order.

G. Any failure to comply with approved schedules of activities required under this Order shall be a failure to comply with this Order.

H. In this Order, any reference to the singular includes the plural.

I. Further, I, James E. Word, do not waive any rights or authority available to me to assess the International Harvester Company for liability for costs, expenditures, civil penalties or damages incurred by the State pursuant to this Order. I also reserve the right to order such further remedial action to be completed by the Respondent where it is determined that further remedial action is needed.

Issued in this office of the Commissioner of the Tennessee Department of Health and Environment this 14th day of March, 1984.

JAMES E. WORD, Commissioner
Tennessee Department of Health and Environment

NOTICE OF RIGHTS

International Harvester Company is hereby advised that in accordance with T.C.A. Section 68-46-215 it may secure a review of the necessity for or reasonableness of this Order by filing with the Commissioner, a written petition setting forth the grounds and reason for objection and asking for a hearing in the matter involved before the Solid Waste Disposal Control Board. The Order shall become final and not subject to review unless the person or persons named herein shall file such petition for a hearing no later than thirty (30) days after the date such Order is secured. Hearings will be conducted in accordance with the Tennessee Uniform Administrative Procedures Act.

Correspondence regarding this Order should be addressed to William L. Penny, Assistant General Counsel, 150 9th Avenue, North, Nashville, Tennessee 37203 or telephone (615)741-3657.

William L. Penny
Assistant General Counsel

WLP/bec/Intern Harv

 AH 2515

DIVISION OF SUPERFUND SITE IDENTIFICATION NUMBER: #79-525

STATEMENT OF HAZARDOUS SUBSTANCE SITE DISPOSITION:

From 1940's to 1982, International Harvester disposed of hazardous substances including oils, grease, spent transformer oil and paint sludge. The graded landfill is covered with a cap of 6 inches of clay and an additional one foot of clean soil. The site is in monitoring and maintenance phase. Many of the contaminants remain in place. The landfill area is located approximately 250 feet west of the main plant building and should not be disturbed without authorization from the Tennessee Department of Health and Environment, Division of Superfund.

Executed this 29th day of February, 1988.

TENNESSEE DEPARTMENT OF HEALTH AND ENVIRONMENT
JAMES E. WORD, COMMISSIONER

BY: James C. Ault
James C. Ault, Director
Superfund Division
Tennessee Department of Health and Environment
701 Broadway
4th Floor, Customs House
Nashville, Tennessee 37219-5403

STATE OF TENNESSEE

COUNTY OF DAVIDSON

Before me, the undersigned Notary Public in the State and County aforesaid, personally appeared James C. Ault, with whom I am personally acquainted, and who, upon oath acknowledged himself to be Director of the Division of Superfund, Tennessee Department of Health and Environment, and that he as such Director, executed the foregoing instrument by his signature for the purpose therein contained, by delegated authority from the Commissioner of the Department of Health and Environment.

WITNESS, my hand and Official Seal at office this 29th day of February, 1988.

Marion S. Thompson
NOTARY PUBLIC

AH 2515

My Commission Expires: My Commission Expires April 17, 1988

F4098057/SF-10A

Reference 10

RECEIVED
OCT 29 1987

REPORT OF POST CLOSURE MONITORING
AT THE
INTERNATIONAL HARVESTER LANDFILL SITE
MEMPHIS, TENNESSEE
-THIRD QUARTER, FIRST YEAR-

Prepared by
Hess Environmental Services, Inc.
Memphis, Tennessee

October 6 , 1987

Hess Environmental Services, Inc.
6890 Hillshire Drive, Suite 13
Memphis, Tennessee 38134
(901) 377-9139

October 6, 1987

Dr. Sheldon Kelman
The Pickering Firm
821 Barksdale, South
Memphis, Tennessee 38114

Dear Dr. Kelman:

Hess Environmental Services, Inc. (HES) has prepared the enclosed "Report of Post Closure Monitoring at the International Harvester Landfill Site, Memphis, Tennessee, Third Quarter, First Year." If you have any questions or comments concerning this report, please feel free to contact me at your convenience.

Dr. Kelman, I have enjoyed working with you on this project and look forward to sampling this site again next quarter.

Sincerely,

Connie Hess

Connie Hess, CHMM
President

mm

Enclosure

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Tables

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Appendix

SUMMARY

First year, third quarter groundwater, surface water, sediment and soil samples were collected and analyzed in compliance with post closure monitoring requirements set forth in International Harvester's Closure Plan as enforced by the State of Tennessee.

All water samples were analyzed for chromium and lead content. All sediment and soil samples were analyzed for chromium, lead and Polychlorinated Biphenyls (PCBs) content.

The downgradient well (#4) was found to be dry this quarter.

No metals were detected in any of the groundwater samples collected. Hence, the landfill can not be said to have impacted groudwater surrounding it.

No metals were detected in the surface water composite. Metals and PCBs were found in both soil composites, however these levels were comparable with levels previously found at this site.

Metals, but no PCBs were found in the sediment composite sample collected. The sediment chromium level was comparable with published soil levels referenced in table IV and the lead level in the sediment was below the average level found in a recent study of Memphis soils (HES 1986).

All data is displayed in Table IV of this report.

I. INTRODUCTION

To comply with post closure monitoring requirements set forth in the International Harvester (IH) Closure Plan and enforced by the State of Tennessee, Department of Health and Environment, Division of Superfund (the State), Hess Environmental Services, Inc. (HES) collected groundwater samples from three (3) groundwater monitoring wells (down gradient well #4 was dry), water and sediment samples from the National Pollutant Discharge Elimination System (NPDES) discharge point and soil samples from two (2) areas at the base of the landfill.

All samples were analyzed for chromium and lead content. The soil samples collected below the landfill and the sediment sample collected from the NPDES discharge point were also analyzed for PCB content.

This report addresses sampling, testing and chain-of-custody protocols followed to fulfill third quarter, first year, post closure monitoring requirements.

II. SAMPLE COLLECTION

On September 3 1987, HES provided a team to collect: groundwater, samples from three (3) downgradient wells (#2, #3, and #4) and one (1) upgradient well (#1); one (1) sediment composite and one (1) surface water composite from the (NPDES) discharge point ditch; and two (2) soil composites, the first from below the landfill on the north side, and the second from below the landfill on the south side; no groundwater sample was collected from well #4 this quarter, because it was found to be dry (no water was present in the well). All samples collected at the IH Landfill Site, parcel 4, are shown in Figure 1.

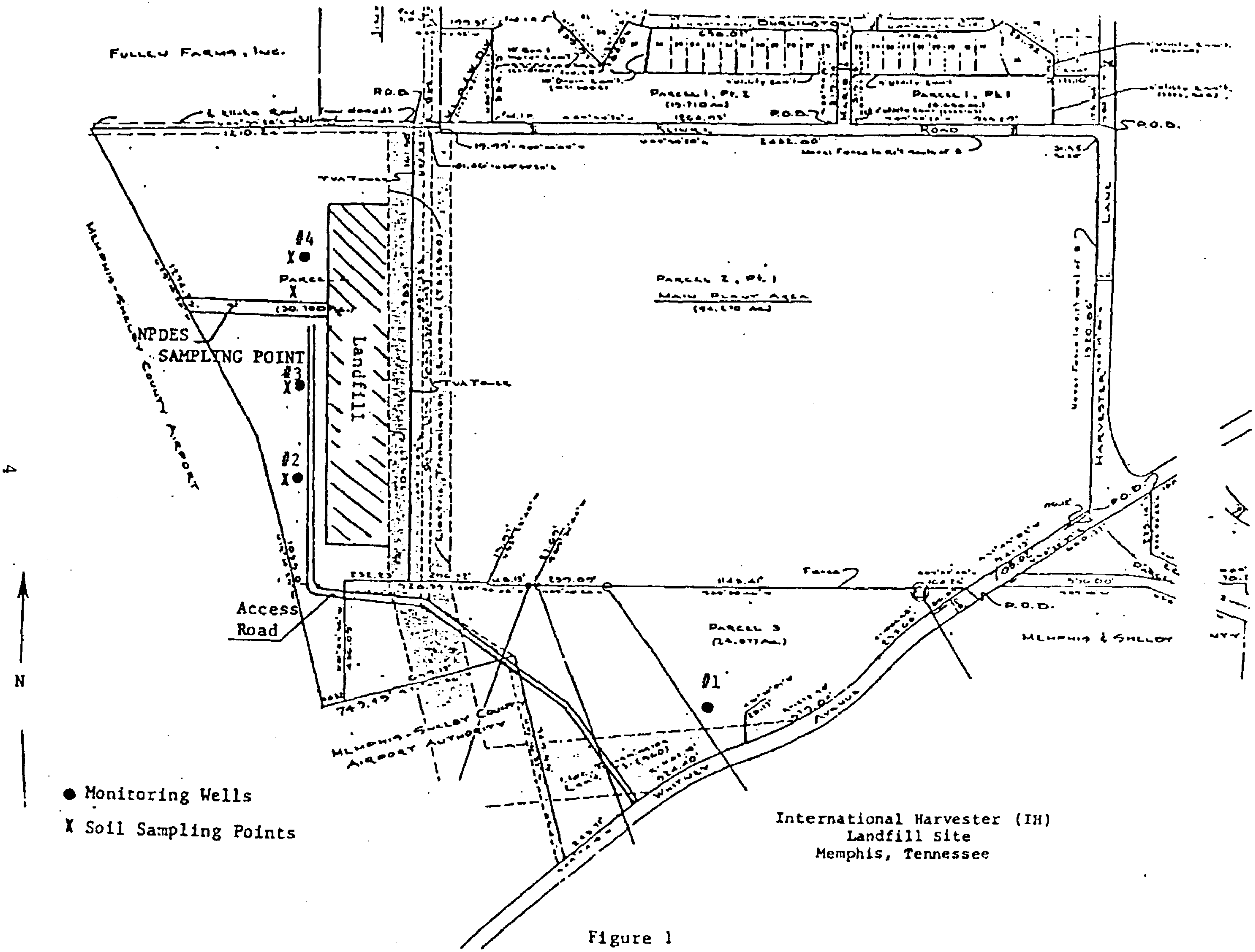
Present on site during sample collection were:

Connie Hess - Senior Chemist with HES
Larry Stewart - Senior Chemist with HES
Marolyn Howe - Chemical Engineer with HES
Bobby King - Environmental Engineer with the State
Bijan Haghtaleb - Environmental Engineer with the State

Weather conditions were mild, sunny & 22° (72°F).

Groundwater Monitoring Wells

Each of the four (4) two inch ID groundwater monitoring wells had a metal outer well casing with a pad-locked lid. HES found all lids locked. Before sampling, the well depth and the depth to the surface of the groundwater was measured in each well containing water and the volume of the standing water calculated. A record of these measurements is shown in Table I. A Well Wizard, stainless steel portable positive gas displacement bladder pump, Model ST110P, with a Teflon bladder, Teflon tubing and a stainless steel intake screen,



International Harvester (IH)
Landfill Site
Memphis, Tennessee

Figure 1

TABLE I

MONITORING WELL
MEASUREMENTS

WELL NUMBER	1	2	3	4
Total Depth of Well (Ft.)	41.5	24.8	25.0	25.0
Depth from MP* to Top of Water Column (Ft.)	32.7	21.6	22.3	25.0
Height of Water Column (Ft.)	8.8	3.2	2.7	0.0

*MP = Measuring Point, an area (point) at the top of each PVC well casing used as a reference point for measurements.

was used to evacuate one (1) volume of standing water and three (3) volumes of recharge water in wells #1 and #2. Well #3 was bailed to dryness and then a sample collected using a Teflon bailer. This is in accordance with the protocol described in the Environmental Protection Agency's (EPA), <u>Resource Conservation and Recovery Act (RCRA), Groundwater Monitoring Technical Enforcement Guidance Document</u>. Well #4 was found to be dry, therefore no water was evacuated and no sample was taken. Groundwater to be sampled was then pumped into precleaned glass sample containers with Teflon lined lids.

Groundwater samples collected for chromium and lead analysis from well #1 and #2 were filtered using a 0.45 micron filter attached to the discharge tube of the ST 1100P pump. Groundwater samples from well #3 were filtered by the laboratory. Wells #2 and #3 exhibited very slow recharge rates which was consistent with first and second quarter findings.

Because of the lack of rainfall in recent months, the water column in each well was lower than levels measured during previous sampling events.

All groundwater samples were stored on ice (4^{o}) immediately after collection (in the field). Groundwater from wells #1 and #2 to be analyzed for metals were pH adjusted with nitric acid to a pH of <2 and refrigerated (4^{o}) along with the rest of the sample. Groundwater from well #3 was preserved at the laboratory, after filtering. with nitric acid to a pH of less <2.

All sampling equipment and sample container cleaning procedures, sample preservation procedures and analytical procedures were performed in accordance with "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March, 1979, as referenced in the "Rules Governing Hazardous Waste Management in Tennessee." See Table II for the specific analytical method references for each parameter.

Environmental Testing & Consulting, Inc. (ETC), received samples from the three (3) wells. ETC is a laboratory certified by the State of Tennessee (Cert. #00210). Samples were delivered to ETC by HES van on September 3, 1987.

All samples arrived at the laboratory with seal intact.

Established chain-of-custody sample handling protocols were followed. A "Field Log Book" was kept, as required in the chain-of-custody protocol. Pertinent data concerning the site in general, weather conditions, and data collected during the sampling event were recorded. This log will be updated during each quarter's sampling event.

TABLE II

ANALYTICAL METHOD

PARAMETER	WATER SAMPLES METHOD REFERENCE	SOIL/SEDIMENT SAMPLES METHOD REFERENCE
Chromium	302D*, 303A*	302D*, 303A*
Lead	302D*, 303A*	302D*, 303A
PCBs	-	3550, 8080**

*Standard Methods for the Examination of Water and Wastewater, 16th Edition, American Public Health Association, Inc., New York, New York, 1985.

**Test Methods for Evaluating Solid Waste, Physical Chemical Methods, SW-846, third Edition, Revised, 1986 U.S. Environmental Protection Agency.

NPDES Discharge Point

Samples were collected at the NPDES discharge sampling point below the discharge of storm water located in the northwest area of parcel 4 (see Figure 1). A water and then a sediment composite were collected from this discharge point.

HES personnel collected grab samples of water from two (2) locations along the south bank in the vicinity of the NPDES discharge point. Water was scooped from each location via a clean glass sampling jar then added to a second jar to form the composite. Equal portions of water from each grab sample were poured into the composite accumulation jar; when all grabs were deposited into the accumulation jar the sample was pH adjusted to pH <2 with nitric acid, then covered with a Teflon lined lid.

There appeared to have been little if any flow in the NPDES discharge ditch. Only pools of standing water were present at the time of this sampling event.

Four (4) sediment grab samples were collected in the same area as the water grabs. Sediment grabs were scooped from the rocky stream bed by raking a sampler, comprised of a small stainless steel beaker attached to a stainless steel pole, across each area then pouring each scoop raked, into a glass sampling jar. The sediment accumulated in the jar was then stirred with a stainless steel spatula to form a uniform composite. The jar was then covered with a Teflon lined lid.

Both composite samples were sealed by placing a chain-of-custody seal across each jar lid and down the sides of the jar. The water sample was stored on ice (4^{o}C) along with the groundwater samples. Both samples were delivered along with the monitoring well samples, to ETC, via HES van on September 3, 1987.

Soil Composites

Two (2) soil composite samples were collected at the landfill site, one north and the second south of the NPDES (and storm water) discharge point, below the west face of the landfill.

All areas sampled are shown in Figure I. A description of the soil areas sampled is provided in Table III.

The north and south soil composites were formed by collecting two (2) cores from each of two (2) locations and depositing them in a precleaned Pyrex glass mixing tray. The soil was then mixed in the tray with a stainless steel spatula to form as uniform a composite as possible then placed in a sample jar. The composite jars were then covered with a Teflon lined lid and sealed with a chain-of-custody seal.

Both soil composites were delivered to ETC, via HES van along with the water and sediment samples on September 3, 1987.

TABLE III

LOCATION OF SOIL COMPOSITES COLLECTED

Composites	Locations Sampled
South Composite:	
Grab S1	18 feet due west of well #2
Grab S2	18 feet due west of well #3
North Composite:	
Grab N1	15 feet due west of well #4
Grab N2	51 feet north and 15 feet west of the north concrete retaining wall at the NPDES discharge point

III. DISCUSSION OF DATA

As stipulated in the IH Closure Plan, all water, soil and sediment samples were analyzed for chromium and lead content. The soil and sediment samples were also analyzed for PCB content.

All soil and sediment sample data is reported on the basis of dry weight (mg/kg).

A summary of all second quarter laboratory data is presented in Table IV, the actual laboratory report is included in the Appendix of this report.

No chromium or lead was detected in groundwater from any of the wells. No metals were detected in the surface water composite. Chromium and lead were found in the sediment and soil composites. PCBs were found current soil composites, but not in the sediment composite.

Third quarter groundwater data for the downgradient wells was comparable with first and second quarter data. The absents of chromium in third quarter groundwater from upgradient well #1 may reflect normal variations in groundwater quality.

Current surface water data is comparable with first and second data. The variations in sediment data probably reflect variations in constituent concentrations at different points in the NPDES stream bed.

Third quarter (site) soil data was comparable with previous data. The relatively small variations in data probably reflect a combination of the ranges present in site soil and normal variations in laboratory data.

TABLE IV

SUMMARY OF DATA

Groundwater Monitoring Wells	Units	Chromium	Lead	PCBs
#1	mg/l	<0.02	<0.05	-
#2	mg/l	<0.02	<0.05	-
#3	mg/l	<0.02	<0.05	-
NPDES Discharge Pt.				
Surface Water Comp.	mg/l	<0.02	<0.05	-
Sediment Comp.	mg/Kg*	144	144	<0.05
Soils				
N. Landfill Comp.	mg/Kg*	21.7	38.4	0.64
S. Landfill Comp.	mg/Kg*	11.9	15.9	0.24
Average Background Levels				
Soil	mg/Kg	100(1)	313(2)**	<1(3)

References

(1)
Allaway, W. H. 1968. Agronomic controls over the environmental cycling of trace elements. Adv. Agron. 20: 235-274.

(2)
Final Report of Soil Sampling and Analysis for the North Hollywood Dump Health Effects Study, Hess Environmental Services, Inc., May 30, 1986.

(3)
Richardson, B. J. and Waid, J. S. (1982). Polychlorinated biphenyls (PCBs): An Australian viewpoint on a global problem. Search 13, 17.

*Dry Weight Basis

**Range 40.7 to 2002 mg/Kg.

IV. CONCLUSIONS

* Because no metals were found in downgradient groundwater, the landfill can not be said to have impacted groundwater surrounding it.

* Site surface water and soil composites do not contain contaminants of interest above published background levels.

* The groundwater level in all wells was lower than, noted first and second quarter monitoring.

* Most third quarter data is comparable with first and second quarter data with the following exceptions: the level of chromium in background groundwater decreased, the level of lead and PCBs in the sediment decreased and the level of chromium in the sediment increased slighty. The relatively minor variations in data reported to date probably reflect a combination of the ranges present in soil and sediments at the site and normal variations in laboratory data.

No actions beyond reporting the data contained in this report should be required until fourth quarter, first year, when monitoring will again be required.

APPENDIX
LABORATORY REPORT

ENVIRONMENTAL TESTING & CONSULTING INC.
2924 WALNUT GROVE RD. • MEMPHIS, TENN. 38111 • PHONE (901) 327-2750

September 18, 1987

RECEIVED SEP 2 3 1987

Ms. Connie Hess, President
Hess Environmental Services, Inc.
6890 Hillshire Drive, Suite 13
Memphis, Tenn. 38134

REF: ANALYTICAL TESTING - WATER SAMPLES
SAMPLE(S) DATE: 9/3/87
SAMPLE(S) I.D.: MUF (1,2,3 & 5)

Dear Ms. Hess:

The above referenced samples have been analyzed per your instructions. The tests were performed in our laboratory (#00210) in accordance with Standard Methods, 16th Edition, and the results are shown below.

Tests	Results (mg/1) #1	#2	*#3	#5	Standard Methods Page #	By	Date
Chromium	<0.02	<0.02	<0.02	<0.02	157	JF	9/4
Lead	<0.05	<0.05	<0.05	<0.05	157	JF	9/4

* Filtered through a 0.45 micron filter.
Analyses on filtrate.

If you have any questions please feel free to contact me.

Very truly yours,

Michael J. Cimbalo
President

MJC/mg

Attachment

ENVIRONMENTAL TESTING & CONSULTING INC.

2924 WALNUT GROVE RD. • MEMPHIS, TENN. 38111 • PHONE (901) 327-2750

September 18, 1987

Ms. Connie Hess, President
Hess Environmental Services, Inc.
6890 Hillshire Drive, Suite 13
Memphis, Tenn. 38134

REF: ANALYTICAL TESTING
SAMPLE(S) DATE: 9/3/87
SAMPLE(S) I.D.: MUF #1 & #2
SOIL & SEDIMENT SAMPLES

Dear Ms. Hess:

The above referenced samples have been analyzed per your instructions. The tests were performed in our laboratory (#00210) in accordance with Standard Methods, 16th Edition, and SW-846, Methods 8080/3550*(PCBs). The results are shown below.

Tests	Soil Samples MUF Results (ppm) #1	Soil Samples MUF Results (ppm) #2	Sediment MUF (ppm) #1	Standard Methods Page #	By	Date
Chromium	21.7	11.9	144	157	JF	9/8
Lead	38.4	15.9	144	157	JF	9/8
PCBs	0.64	0.24	<0.05	*	RR	9/17

If you have any questions please feel free to contact me.

Very truly yours,

Michael J. Cimbalo
President

MJC/mg

Attachment

DSF, JFO, F..

Reference 11

STATE OF TENNESSEE
DEPARTMENT OF HEALTH AND ENVIRONMENT
SOUTHWEST TENNESSEE REGIONAL OFFICE
295 SUMMAR AVENUE
JACKSON, TENNESSEE 38301-3984

July 10, 1989

Dr. Sheldon Kelman, P. E.
Vice President
The Pickering Firm
Suite 500
1750 Madison Avenue
Memphis, TN 38104

Re: International Harvester Landfill Site, TDSF #79-525

Dear Dr. Kelman:

The International Harvester Site was inspected on 6/29,89 (see enclosed trip report). Although many problems have been corrected, there still exist some serious deficiencies at the site. In particular:

1. Many areas on the cap and slopes of the cap are eroded with waste visible at the surface.

2. Areas that have apparently been re-covered and seeded are eroding.

3. The gate erected at the Whitney Road entrance is secured only with a wire (a lock should be purchased and a key made available to the Division).

4. Mowing has been restricted to only the cap and access road. Mowing around the monitoring wells will also be required for obvious reasons.

If a joint site inspection is required to adequately define these problems please feel free to contact me at (901) 424-9200.

Sincerely,

Wm Jordan English
Geologist, TDSF

Enclosure

cc: Edith Ardiente

Reference 12

HAZARDOUS WASTE SITE INVESTIGATION
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE
MARCH, 1981

INTRODUCTION

A hazardous waste site investigation was conducted at the International Harvester Company, Memphis, TN, during October 20-21, 1980 by J. S. Hall and Charles A. Till of the US Environmental Protection Agency (US-EPA), Region IV, Surveillance and Analysis Division (SAD). This investigation was initiated following a preliminary inspection by personnel of the US-EPA, Region IV, Enforcement Division in May 1980 (1). During the May 1980 inspection, US-EPA, investigators observed wood, pallets, crates, metal, paper, trash, glass, and drums in a landfill adjacent to the plant. The drums in the landfill were alledged to be empty (with the exception of some yellow drums filled with trash), and could not be sold or reconditioned. These drums were not accessible, so their contents or lack thereof were not verified by the US-EPA. The drums that were not sold or reconditioned were supposed to be crushed. There were also approximately 1000 empty drums stacked along the northeastern side of the landfill near the back entrance gate of the plant. The original contents of these drums were reported to be oil, paint, varnish, sealing compound, caustics, and hydrochloric acid.

STUDY AREA

The International Harvester Plant is located at 3003 Harvester Lane on the northwestern side of Memphis (see figure 1). The plant manufactures farm equipment. The manufacturing processes include casting, shearing, machining, welding, assembly, washing, plating, and painting. In addition to manufacturing complete pieces of equipment, the plant also manufactures parts to be shipped to other International Harvester Plants.

The subject landfill is located to the west of the plant. The landfill and adjacent area are situated on the Mississippi River floodplain. All runoff from the landfill drains toward the Mississippi River via a large drainage ditch. The soils around the landfill are floodplain alluvium that consist of materials formed from silts and clays washed from the adjacent uplands, and from silts, clays, sands and gravels deposited by the Mississippi River. The area immediately downgradient from the landfill is presently being farmed. The topography of the area consists of gently sloping uplands to nearly flat to flat bottom lands. (See figure 2 for site map)

During this investigation, four sediment, one soil, and two water samples were collected. Three sediment samples (IH-2, IH-3, IH-4) were collected in depositional areas downgradient from the landfill. A composite soil sample (IH-5) was collected from random locations on top of the landfill. The two water samples IH-6 and IH-001, and another sediment sample IH-7 were collected in the drainage ditch that conveys wastewater from the plant and surface runoff from the landfill to the Mississippi River (see figure 2 for sampling locations). All sampling points were located on International Harvester Company property.

DISCUSSIONS AND RESULTS

The soil and sediment samples were analyzed for organic compounds and metals. Water sample IH-6 was analyzed for organic compounds, metals, and cyanide. Water sample IH-001 was collected for an NPDES inspection so it was analyzed only for metals and other permitted parameters. Results of the NPDES investigation were forwarded January 29, 1981, and are not discussed in this report.

Sampling station locations are included in Table 1. All data included in tables 2 and 3 include only metals and organic compounds that were positively identified and quantified by laboratory analyses. Several organic compounds were tentively identified and concentrations were estimated; also, some trace concentrations (below the minimum detection level (MDL) of organic compounds and metals were detected but were too low to be quantified. These data, along with all of the analytical results, are included with the analytical data sheets in Attachment 1. Attachment 2 contains all of the field data record sheets.

Extractable and Purgeable Organic Compounds

3,4-benzofluoranthene and/or 11,12-benzofluoranthene was detected at a concentration of 1,500 ug/kg in the sediment sample (IH-3) collected in the small drainage ditch on the western side of the landfill. This sample would have been affected by runoff from most of the landfill area except for the northwest portion. Trace concentrations of eight other extractable organic compounds were detected, but were too low to be quantified (<1,000 ug/kg), including: naphthalene, phenanthrene and/or anthracene, fluoranthene, pyrene, chrysene and/or 1,2-benzanthracene, 3,4-benzopyrene, 1,12-benzoperylene, and phenol (<2,200 ug/kg). Also, 13 other extractable organic compounds were tentatively identified in this sample with estimated concentrations or concentrations too low to be quantified. (See Attachment 1).

Sediment sample IH-2, collected in a depositional area collected at the southern part of the site, contained trace concentrations of nine extractable organic compounds but were too low to be quantified (<1,000 ug/ kg). These were: naphthalene, phenanthrene and/or anthracene, fluoranthene, pyrene, 1,2-benzanthracene, 3,4-benzofluoranthene and/or 11,12-benzofluoranthene , 3,4-benzopyrene, 1,12-benzoperylene, and phenol (<500 ug/kg). Ten other extractable organic compounds were tentatively identified with estimated concentrations or concentrations too low to be quantified.

Sediment sample IH-4, collected in a depositional area of the northern part of the site, contained a trace concentration of phenol (<1,000 ug/kg). There were also four other extractable organic compounds tentatively identified with estimated concentrations or concentrations too low to be quantified.

Soil sample IH-5 collected on the landfill, contained trace concentrations of fluoranthene (<15,000 ug/kg) and pyrene (<15,000 ug/kg). Also, one other extractable organic compound was tentatively identified in IH-5, but the concentration was too low to be quantified.

Sediment sample IH-7, collected from the large drainage ditch below the site, contained seven extractable organic compounds that were tentatively identified with estimated concentrations, or concentrations too low to be quantified.

The water sample IH-6, collected from the large drainage ditch below the site, contained no detectable extractable organic compounds.

The only purgeable organic compound detected in any of the soil and sediment or water samples collected during this investigation was dichlorodifluoromethane at a trace concentration (<5 ug/kg) in soil sample IH-4.

Chlorinated Organic Compounds

Polychlorinated biphenyls (PCB's) were detected in all of the soil and sediment samples. The concentrations and compounds were as follows: (IH-2), PCB (Aroclor 1248, 18,000 ug/kg); (IH-3), PCB (Aroclor 1248, 5,500 ug/kg); (IH-4), PCB (Aroclor 1248, 8,900 ug/kg); (IH-5), PCB (Aroclor 1254, 3,800 ug/kg); and (IH-7); PCB (Aroclor 1254, 180 ug/kg). These data indicate that PCB concentrations were higher in the landfill area than in the drainage ditch sediments downgradient from the landfill (see figure 2 and table 2). PCB's have been used in numerous commercial applications such as plasticizers, heat transfer fluids, hydraulic fluids, fluids in vacuum pumps and compressors, lubricants, and wax extenders. (2)

Metals

Iron was detected in all of the soil and sediment samples ranging in concentration from 21,360 ug/kg to 41,000 ug/kg. Sediment sample IH-3 contained lead at a concentration of 112 ug/kg, and zinc at a concentration of 147 ug/kg. Sediment sample IH-4 contained chromium, 141 ug/kg; lead, 468 ug/kg, and zinc, 175 ug/kg. Sediment sample IH-7 contained chromium, 278 ug/kg; lead 210 ug/kg; and zinc, 174 ug/kg. Soil sample IH-5 contained chromium at a concentration of 104 ug/kg. Chromium was detected in water sample IH-6 at a concentration of 104 ug/L. None of the other metals detected in the soil, sediment or water samples displayed high concentrations (3) (See table 2 for concentrations).

METHODOLOGY

All sampling and preservation methods used during this investigation were in accordance with the Water Surveillance Branch Standard Operating Procedures and Quality Assurance Manual, August 29, 1980 (4). Chain-of-custody was maintained from time of collection until samples were relinquished to Laboratory Services Branch (LSB) personnel at the North Treatment Plant in Memphis.

Analyses were conducted by the US-EPA, SAD, Laboratory Services Branch (LSB) and Mead Technology (contract laboratory). The soil, sediment and water samples were analyzed for organic compounds and metals by the (LSB). Water sample IH-6 was analyzed by Mead Technology for organic compounds. The (LSB) analyzed water sample IH-6 for metals and cyanide. Water sample IH-001 was analyzed by the (LSB) for NPDES parameters.

REFERENCES

1. "Report - Hazardous Waste Site Investigation - Memphis, Tennessee - First Phase", US Environmental Protection Agency, Region IV, Enforcement Division; June 1980.

2. Ambient Water Quality Criteria for Polychlorinated Biphenyls United States Environmental Protection Agency, EPA-440/5-80-068, 1980.

3. Hazardous Waste Site Investigation, Frayser Pond Site, Memphis, TN. US Environmental Protection Agency, Region IV, Surveillance and Analysis Division, September 17, 1980.

4. Water Surveillance Branch Standard Operating Procedures and Quality Assurance Manual. (Draft); US Environmental Protection Agency Region IV, Surveillance and Analysis Division, August 29, 1980.

Table 1
Sampling Locations
International Harvester Company
Memphis, Tennessee
March, 1981

Field Identification	SAD No.	Date	Time	Description	Type Sample
IH-2	81C 0103	10/20	1045	Depositional area below the southern most part of landfill.	Sediment
IH-3	81C 0104	10/20	1100	Depositional area below landfill in drainage ditch on western side of site	Sediment
IH-4	81C 0106	10/20	1120	Area below landfill on northern most part of dump.	Sediment
IH-5	81C 0105	10/20	1130 1145	Composite sample from several locations on top of landfill.	Soil
IH-6	81C 0108	10/20	1420	Effluent ditch at culvert and field rd. Approx. 1000 ft. below NPDES discharge pipe.	Water
IH-7	81C 0107	10/20	1425	Effluent ditch at culvert and field rd. Approx. 1000 ft. below NPDES discharge pipe.	Sediment
IH-001	81C 0150	10/21	0935	NPDES outfall in ditch discharging from the plant.	Water

Table 2
Analytical Results
Soil Samples
International Harvester Company
Memphis, Tennessee
March, 1981

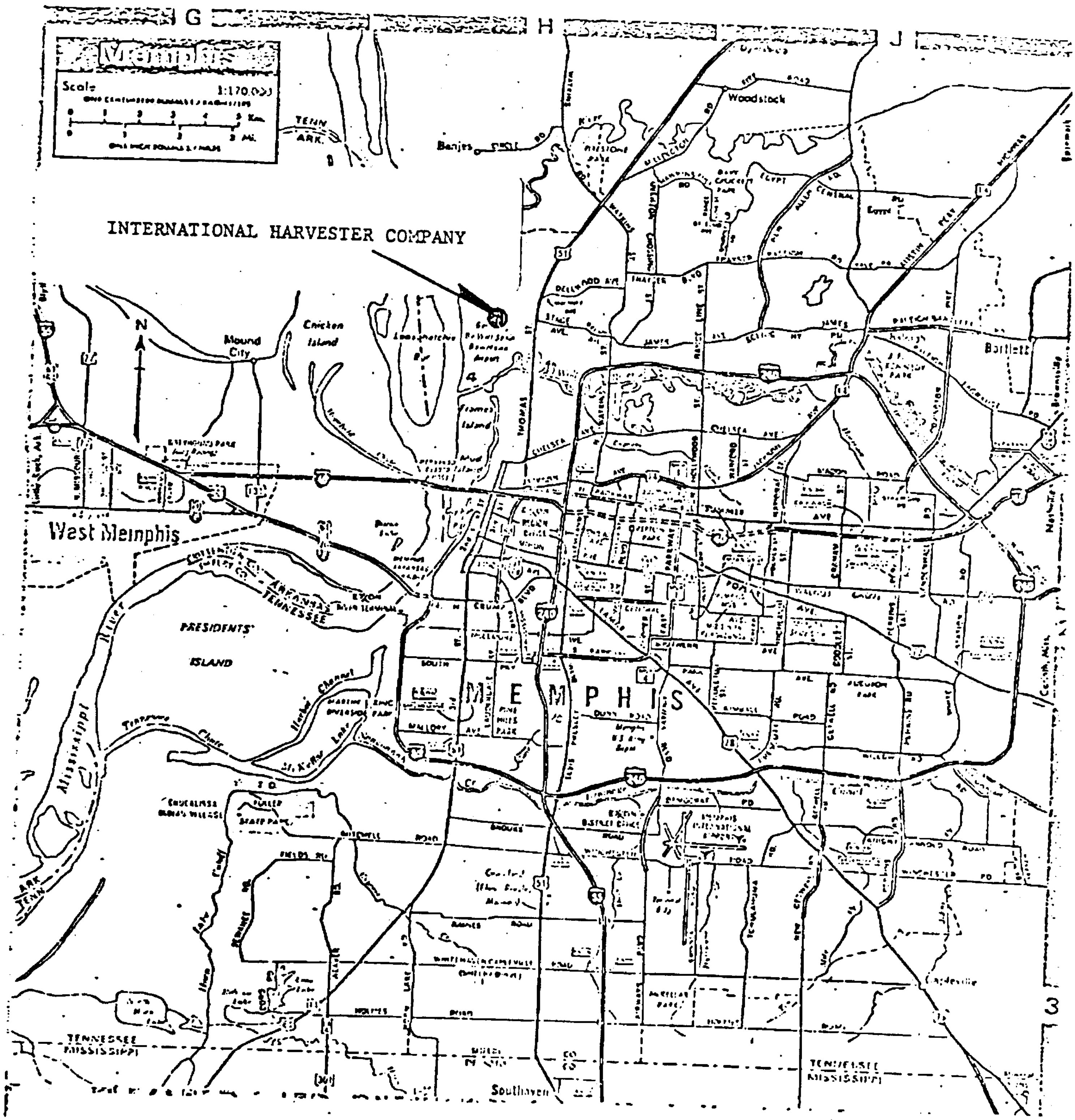
Parameter	Sample Locations				
	IH-2	IH-3	IH-4	IH-5	IH-7
3,4 - benzofluoranthene and/or 11,12 - benzofluoranthene (ug/kg)	ND	1500	ND	ND	ND
Barium (mg/kg)	111	199	316	68	221
Cadmium (mg/kg)	ND	ND	ND	ND	4
Chromium (mg/kg)	30	44	141	104	278
Copper (mg/kg)	26	40	74	50	37
Nickel (mg/kg)	18	31	35	29	33
Lead (mg/kg)	70	112	468	57	210
Strontium (mg/kg)	37	48	92	46	41
Titanium (mg/kg)	275	533	320	112	224
Vanadium (mg/kg)	19	49	27	17	55
Yttrium (mg/kg)	5	11	8	4	14
Zinc (mg/kg)	83	147	175	54	174
Zirconium (mg/kg)	4	ND	5	ND	ND
Mercury (mg/kg)	ND	ND	ND	ND	0.1
Calcium (mg/kg)	17,638	13,170	19,300	6,591	6,050
Magnesium (mg/kg)	5,176	7,497	6,800	2,977	5,350
Aluminum (mg/kg)	7,282	20,985	15,900	6,200	23,750
Iron (mg/kg)	21,360	30,990	41,100	29,680	31,050
Manganese (mg/kg)	502	786	665	426	875
Sodium (mg/kg)	ND	ND	545	390	ND
PCB, (Aroclor 1248) (ug/kg)	18,000	5,500	8,900	ND	ND
PCB, (Aroclor 1254) (ug/kg)	ND	ND	ND	3,800	180

Note: ND - Indicates material was analyzed for but not detected at or above the minimum detection limit.

Table 3
Analytical Results
Water Sample (IH-6) and NPDES Discharge Sample (IH-001)
International Harvester Company
Memphis, Tennessee
March, 1981

Parameter	IH-6	IH-001
	(ug/L)	(ug/L)
Barium	41	38
Chromium	104	58
Copper	14	11
Molybdenum	215	68
Strontium	44	38
Aluminum	300	154
Calcium	13	13
Magnesium	5.9	6
Iron	1.0	0.6
Sodium	17.0	12

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE



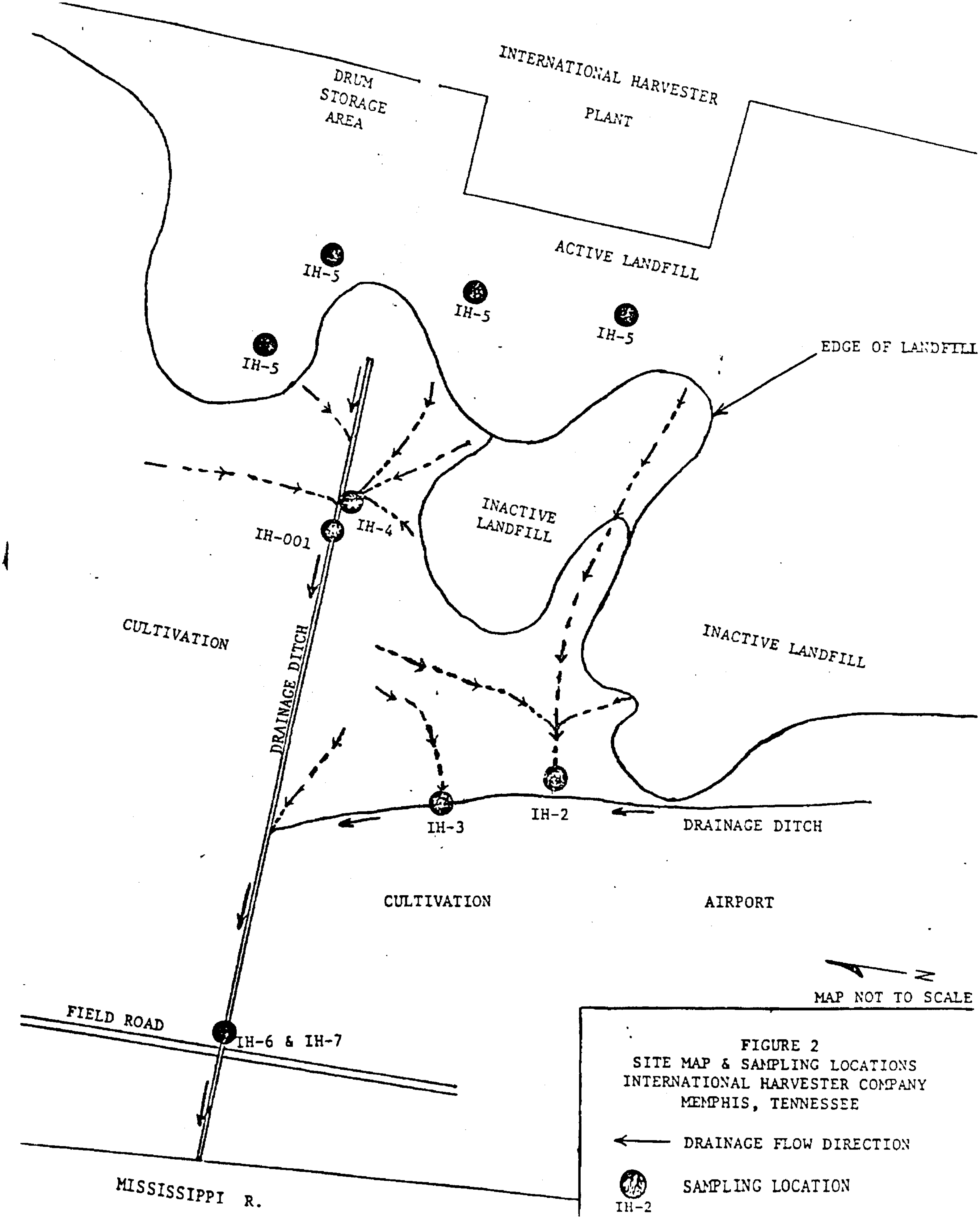


FIGURE 2
SITE MAP & SAMPLING LOCATIONS
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

ATTACHMENT 1

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester
Memphis, TN

CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26-81

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C C103		
SOURCE & STATION		IH-2 Depositional area below So. most part of dump.		
DATE/TIME		10-20-80 @ 1045		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	1000U		
26. 1,3-dichlorobenzene	34569	1000U		
27. 1,4-dichlorobenzene	34574	1000U		
18. bis(2-chloroethyl) ether	34276	1000U		
12. hexachloroethane	34399	1000U		
42. bis(2-chloroisopropyl) ether	34286	1000U		
63. N-nitrosodi-n-propylamine	34431	2000U		
56. nitrobenzene	34450	1000U		
52. hexachlorobutadiene	39705	1000U		
8. 1,2,4-trichlorobenzene	34554	1000U		
55. naphthalene	34445	1000K		
43. bis(2-chloroethoxy) methane	34281	1000U		
54. isophorone	34411	2000U		
53. hexachlorocyclopentadiene	34389	1000U		
20. 2-chloronaphthalene	34584	1000U		
77. acenaphthylene	34203	1000U		
1. acenaphthene	34208	1000U		
71. dimethyl phthalate	34344	1000U		
35. 2,4-dinitrotoluene	34614	1000U		
36. 2,6-dinitrotoluene	34629	1000U		
40. 4-chlorophenyl phenyl ether	34644	1000U		
80. fluorene	34384	1000U		
70. diethyl phthalate	34339	1000U		
37. 1,2-diphenylhydrazine 2/	34349	1000U		
62. N-nitrosodiphenylamine 3/	34436	1000U		
9. hexachlorobenzene	39701	1000U		
41. 4-bromophenyl phenyl ether	34639	1000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	1000K		
68. di-n-butyl phthalate	39112	1000U		
39. fluoranthene	34379	1000K		
84. pyrene	34472	1000K		
67. butyl benzyl phthalate	34295	1000U		
5. benzidine	39121	2000U		
66. bis(2-ethylhexyl) phthalate	39102	1000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	1000K		
28. 3,3'-dichlorobenzidine	34634	1000U		
69. di-n-octyl phthalate	34599	1000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	1000K		
73. 3,4-benzopyrene	34250	1000K		
83. indeno (1,2,3-cd) pyrene	34406	1000U		
82. 1,2,5,6-dibenzanthracene	34559	1000U		
79. 1,12-benzoperylene	34524	1000K		
24. 2-chlorophenol	34589	500U		
57. 2-nitrophenol	34594	500U		
65a. phenol (GC/MS)	34695	500K		
34. 2,4-dimethylphenol	34609	500U		
31. 2,4-dichlorophenol	34604	500U		
21. 2,4,6-trichlorophenol	34624	500U		
22. parachlorometa cresol	34455	500U		
59. 2,4-dinitrophenol	34619	4000U		
60. 4,6-dinitro-o-cresol	34660	500U		
64. pentachlorophenol	39061	500U		
58. 4-nitrophenol	34649	1000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.

5/ - Chrysene and/or 1,2-benzanthrac
6/ - 3,4-benzofluoranthene and/or
11,12-benzofluoranthene.

(OVER)

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26-81

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0103		
SOURCE & STATION	IH-2 Depositional area below So. most part of dump.		
DATE/TIME	10-20-80 @ 1045		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
biphenyl 1/	1000K		
dichlorobenzophenone 1/	1000K		
hydroxybenzaldehyde 1/	500K		
C_3 phenol 1/	500K		
C_2 phenol 1/	500K		
tetradecanoic acid, methyl ester 1/	500K		
isobenzofurandione 1/	500K		
pentadecanoic acid, methyl, methyl ester 1/	800J		
octadecenoic acid, methyl ester 1/	900J		
hexadecanoic acid 1/	2700J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 1000 ug/kg

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/- Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN   CHEMIST E.W. Loy, Jr.   REC'D. 10-20-80 COMPL'D. 1-26-81

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0104		
SOURCE & STATION		IH-3 Area below dump ditch on Western side of site.		
DATE/TIME		10-20-80 @ 1100		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	1000U		
26. 1,3-dichlorobenzene	34569	1000U		
27. 1,4-dichlorobenzene	34574	1000U		
18. bis(2-chloroethyl) ether	34276	1000U		
12. hexachloroethane	34399	1000U		
42. bis(2-chloroisopropyl) ether	34286	1000U		
63. N-nitrosodi-n-propylamine	34431	2000U		
56. nitrobenzene	34450	1000U		
52. hexachlorobutadiene	39705	1000U		
8. 1,2,4-trichlorobenzene	34554	1000U		
55. naphthalene	34445	1000K		
43. bis(2-chloroethoxy) methane	34281	1000U		
54. isophorone	34411	2000U		
53. hexachlorocyclopentadiene	34389	1000U		
20. 2-chloronaphthalene	34584	1000U		
77. acenaphthylene	34203	1000U		
1. acenaphthene	34208	1000U		
71. dimethyl phthalate	34344	1000U		
35. 2,4-dinitrotoluene	34614	1000U		
36. 2,6-dinitrotoluene	34629	1000U		
40. 4-chlorophenyl phenyl ether	34644	1000U		
80. fluorene	34384	1000U		
70. diethyl phthalate	34339	1000U		
37. 1,2-diphenylhydrazine 2/	34349	1000U		
62. N-nitrosodiphenylamine 3/	34436	1000U		
9. hexachlorobenzene	39701	1000U		
41. 4-bromophenyl phenyl ether	34639	1000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	1000K		
68. di-n-butyl phthalate	39112	1000U		
39. fluoranthene	34379	1000K		
84. pyrene	34472	1000K		
67. butyl benzyl phthalate	34295	1000U		
5. benzidine	39121	2000U		
66. bis(2-ethylhexyl) phthalate	39102	1000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	1000K		
28. 3,3'-dichlorobenzidine	34634	1000U		
69. di-n-octyl phthalate	34599	1000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	1500		
73. 3,4-benzopyrene	34250	1000K		
83. indeno (1,2,3-cd) pyrene	34406	1000U		
82. 1,2,5,6-dibenzanthracene	34559	1000U		
79. 1,12-benzoperylene	34524	1000K		
24. 2-chlorophenol	34589	2200U		
57. 2-nitrophenol	34594	2200U		
65a. phenol (GC/MS)	34695	2200K		
34. 2,4-dimethylphenol	34609	2200U		
31. 2,4-dichlorophenol	34604	2200U		
21. 2,4,6-trichlorophenol	34624	2200U		
22. parachlorometa cresol	34455	2200U		
59. 2,4-dinitrophenol	34619	11,000U		
60. 4,6-dinitro-o-cresol	34660	2200U		
64. pentachlorophenol	39061	2200U		
58. 4-nitrophenol	34649	4400U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.
4/
5/ - Chrysene and/or 1,2-benzanthrac
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

EPA, SAD, RGN. IV
Athens, GA 4/t

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

PROJECT International Harvester Memphis, TN CHEMIST E.W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-2

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0104		
SOURCE & STATION	IH-3 Area below dump ditch on Western side of site.		
DATE/TIME	10-20-80 @ 1100		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentratic ug/kg
C_3 alkyl benzene 1/	1000K		
methyl naphthalene (2 isomers) 1/	1000K		
biphenyl 1/	1000K		
C_2 alkyl naphthalene (2 isomers) 1/	1000K		
methyl phenanthrene (2isomers) 1/	1000K		
C_3 alkyl phenol 1/	2200K		
tetradecanoic acid, methyl ester 1/	2200K		
tetradecanoic acid, methyl, methyl ester 1/	2200K		
isobenzofurandione 1/	2200K		
pentadecanoic acid, methyl, methyl ester 1/	5900J		
hexadecanoic acid, methyl, methyl ester 1/	2200K		
octadecenoic acid, methyl ester 1/	5000J		
hexadecanoic acid 1/	7100J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 2500 ug/kg

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/- Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester
Memphis, TN
CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 2-3-8

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0106		
SOURCE & STATION		IH-4 Area below dump on Northern most part of dump.		
DATE/TIME		10-20-80 @ 1120		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	40000U		
26. 1,3-dichlorobenzene	34569	40000U		
27. 1,4-dichlorobenzene	34574	40000U		
18. bis(2-chloroethyl) ether	34276	40000U		
12. hexachloroethane	34399	40000U		
42. bis(2-chloroisopropyl) ether	34286	40000U		
63. N-nitrosodi-n-propylamine	34431	80000U		
56. nitrobenzene	34450	40000U		
52. hexachlorobutadiene	39705	40000U		
8. 1,2,4-trichlorobenzene	34554	40000U		
55. naphthalene	34445	40000U		
43. bis(2-chloroethoxy) methane	34281	40000U		
54. isophorone	34411	80000U		
53. hexachlorocyclopentadiene	34389	40000U		
20. 2-chloronaphthalene	34584	40000U		
77. acenaphthylene	34203	40000U		
1. acenaphthene	34208	40000U		
71. dimethyl phthalate	34344	40000U		
35. 2,4-dinitrotoluene	34614	40000U		
36. 2,6-dinitrotoluene	34629	40000U		
40. 4-chlorophenyl phenyl ether	34644	40000U		
80. fluorene	34384	40000U		
70. diethyl phthalate	34339	40000U		
37. 1,2-diphenylhydrazine 2/	34349	40000U		
62. N-nitrosodiphenylamine 3/	34436	40000U		
9. hexachlorobenzene	39701	40000U		
41. 4-bromophenyl phenyl ether	34639	40000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	40000U		
68. di-n-butyl phthalate	39112	40000U		
39. fluoranthene	34379	40000U		
84. pyrene	34472	40000U		
67. butyl benzyl phthalate	34295	40000U		
5. benzidine	39121	80000U		
66. bis(2-ethylhexyl) phthalate	39102	40000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	40000U		
28. 3,3'-dichlorobenzidine	34634	40000U		
69. di-n-octyl phthalate	34599	40000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	40000U		
73. 3,4-benzopyrene	34250	40000U		
83. indeno (1,2,3-cd) pyrene	34406	40000U		
82. 1,2,5,6-dibenzanthracene	34559	40000U		
79. 1,12-benzoperylene	34524	40000U		
24. 2-chlorophenol	34589	7500U		
57. 2-nitrophenol	34594	7500U		
65a. phenol (GC/MS)	34695	7500K		
34. 2,4-dimethylphenol	34609	7500U		
31. 2,4-dichlorophenol	34604	7500U		
21. 2,4,6-trichlorophenol	34624	7500U		
22. parachlorometa cresol	34455	7500U		
59. 2,4-dinitrophenol	34619	60000U		
60. 4,6-dinitro-o-cresol	34660	7500U		
64. pentachlorophenol	39061	7500U		
58. 4-nitrophenol	34649	15000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.
5/ - Chrysene and/or 1,2-benzanthr
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/5

PROJECT Internation Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D 2-1-

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0106		
SOURCE & STATION	III-4 Area below dump on Northern most part of dump		
DATE/TIME	10-20-80 @ 1120		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentrat- ug/kg
1 phenol 1,2 butane diol 1/	7500K	7500K	7600
decanoic acid, methyl ester 1/	7500K	7500K	7600
hexadecanoic acid, methyl ester 1/	9800J	12,000J	7600
octadecanoic acid, methyl ester 1/	9800J	12,000J	7600
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 40000 u/

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/- Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RCM
Athens, GA

PROJECT International Harvester Memphis, TN
CHEMIST E. W. Loy, Jr.   REC'D. 10-20-80   COMPL'D.

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0105		
SOURCE & STATION		IH-5 Composite of 4 sites from top of dump. 10-20-80 @ 1130		
DATE/TIME		10-20-80 @ 1145		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentr ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	15000U		
26. 1,3-dichlorobenzene	34569	15000U		
27. 1,4-dichlorobenzene	34574	15000U		
18. bis(2-chloroethyl) ether	34276	15000U		
12. hexachloroethane	34399	15000U		
42. bis(2-chloroisopropyl) ether	34286	15000U		
63. N-nitrosodi-n-propylamine	34431	30000U		
56. nitrobenzene	34450	15000U		
52. hexachlorobutadiene	39705	15000U		
8. 1,2,4-trichlorobenzene	34554	15000U		
55. naphthalene	34445	15000U		
43. bis(2-chloroethoxy) methane	34281	15000U		
54. isophorone	34411	30000U		
53. hexachlorocyclopentadiene	34389	15000U		
20. 2-chloronaphthalene	34564	15000U		
77. acenaphthylene	34203	15000U		
1. acenaphthene	34208	15000U		
71. dimethyl phthalate	34344	15000U		
35. 2,4-dinitrotoluene	34614	15000U		
36. 2,6-dinitrotoluene	34629	15000U		
40. 4-chlorophenyl phenyl ether	34644	15000U		
80. fluorene	34384	15000U		
70. diethyl phthalate	34339	15000U		
37. 1,2-diphenylhydrazine 3/	34349	15000U		
62. N-nitrosodiphenylamine 3/	34436	15000U		
9. hexachlorobenzene	39701	15000U		
41. 4-bromophenyl phenyl ether	34639	15000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	15000U		
68. di-n-butyl phthalate	39112	15000U		
39. fluoranthene	34379	15000K		
84. pyrene	34472	15000K		
67. butyl benzyl phthalate	34295	15000U		
5. benzidine	39121	30000U		
66. bis(2-ethylhexyl) phthalate	39102	15000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	15000U		
28. 3,3'-dichlorobenzidine	34634	15000U		
69. di-n-octyl phthalate	34599	15000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	15000U		
73. 3,4-benzopyrene	34250	15000U		
83. indeno (1,2,3-cd) pyrene	34406	15000U		
82. 1,2,5,6-dibenzanthracene	34559	15000U		
79. 1,12-benzoperylene	34524	15000U		
24. 2-chlorophenol	34589	500U		
57. 2-nitrophenol	34594	500U		
65a. phenol (GC/MS)	34695	500U		
34. 2,4-dimethylphenol	34609	500U		
31. 2,4-dichlorophenol	34604	500U		
21. 2,4,6-trichlorophenol	34624	500U		
22. parachlorometa cresol	34455	500U		
59. 2,4-dinitrophenol	34619	4000U		
60. 4,6-dinitro-o-cresol	34660	500U		
64. pentachlorophenol	39061	500U		
58. 4-nitrophenol	34649	1000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

5/ - Chrysene and/or 1,2-benzanthracene.
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26-

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0105		
SOURCE & STATION	IH-5 Composite of 4 sites from top of dump.		
DATE/TIME	10-20-80 @ 1130 10-20-80 @ 1145		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
pentadecanoic acid, methyl, methyl ester 1/	500K		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 15,000 ug/kg

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/- Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. [illegible]
Athens, GA [illegible]

PROJECT International Harvester
Memphis, TN

CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 CMPL'D. 2-17[illegible]

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0107		
SOURCE & STATION		IH-7 Eff. ditch at Culvert at field Rd. below pipe		
DATE/TIME		10-20-80 @ 1426		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	5000U		
26. 1,3-dichlorobenzene	34569	5000U		
27. 1,4-dichlorobenzene	34574	5000U		
18. bis(2-chloroethyl) ether	34276	5000U		
12. hexachloroethane	34399	5000U		
42. bis(2-chloroisopropyl) ether	34286	5000U		
63. N-nitrosodi-n-propylamine	34431	10000U		
56. nitrobenzene	34450	5000U		
52. hexachlorobutadiene	39705	5000U		
8. 1,2,4-trichlorobenzene	34554	5000U		
55. naphthalene	34445	5000U		
43. bis(2-chloroethoxy) methane	34281	5000U		
54. isophorone	34411	10000U		
53. hexachlorocyclopentadiene	34389	5000U		
20. 2-chloronaphthalene	34584	5000U		
77. acenaphthylene	34203	5000U		
1. acenaphthene	34205	5000U		
71. dimethyl phthalate	34344	5000U		
35. 2,4-dinitrotoluene	34614	5000U		
36. 2,6-dinitrotoluene	34629	5000U		
40. 4-chlorophenyl phenyl ether	34644	5000U		
80. fluorene	34384	5000U		
70. diethyl phthalate	34339	5000U		
37. 1,2-diphenylhydrazine 2/	34349	5000U		
62. N-nitrosodiphenylamine 3/	34436	5000U		
9. hexachlorobenzene	39701	5000U		
41. 4-bromophenyl phenyl ether	34639	5000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	5000U		
68. di-n-butyl phthalate	39112	5000U		
39. fluoranthene	34379	5000U		
84. pyrene	34472	5000U		
67. butyl benzyl phthalate	34295	5000U		
5. benzidine	39121	10000U		
66. bis(2-ethylhexyl) phthalate	39102	5000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	5000U		
28. 3,3'-dichlorobenzidine	34634	5000U		
69. di-n-octyl phthalate	34599	5000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	5000U		
73. 3,4-benzopyrene	34250	5000U		
83. indeno (1,2,3-cd) pyrene	34406	5000U		
82. 1,2,5,6-dibenzanthracene	34559	5000U		
79. 1,12-benzoperylene	34524	5000U		
24. 2-chlorophenol	34589	2100U		
57. 2-nitrophenol	34594	2100U		
65a. phenol (GC/MS)	34695	2100U		
34. 2,4-dimethylphenol	34609	2100U		
31. 2,4-dichlorophenol	34604	2100U		
21. 2,4,6-trichlorophenol	34624	2100U		
22. parachlorometa cresol	34455	2100U		
59. 2,4-dinitrophenol	34619	17000U		
60. 4,6-dinitro-o-cresol	34660	2100U		
64. pentachlorophenol	39061	2100U		
58. 4-nitrophenol	34649	4200U		

NA - Not analyzed.
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1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.
4/ - Phenanthrene and/or anthracene.
5/ - Chrysene and/or 1,2-benzant[illegible]
6/ - 3,4-benzofluoranthene and/o[illegible] 11,12-benzofluoranthene.

(OVER)

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. I*
Athens, GA 4/

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 2-

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0107		
SOURCE & STATION	IH-7 Eff. ditch at Culvert at Field Rd. below pipe.		
DATE/TIME	10-20-80 @ 1426		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
C_3 alkyl phenol (2 isomers) 1/	2100K		
methyl ester of pentadecanoic acid 1/	2100K		
isobenzo furandione 1/	2100K		
methyl ester of methyl pentadecanoic acid 1/	4800J		
methyl ester of methyl hexadecanoic acid 1/	2100K		
methyl ester of octadecenoic acid 1/	4900J		
hexadecanoic acid 1/	6700J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 5000 ug/

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EPA-SAD, ... Athens, GA 4/80

SEDIMENT
DATA REPORTING SHEET
PURGEABLE ORGANIC ANALYSIS

ATHENS, GA
4/80

PROJECT International Harvester CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPLET'D 12-19-80
Memphis, TN

BASED ON WET WEIGHT BASIS

SAD NO.		81C 0103	81C 0104	81C 0105
SOURCE & STATION		IH-2 Depositional area below dump.	IH-3 Below dump ditch western side.	IH-5 composite of 4 ... top.
DATE/TIME		10-20-80 @ 1045	10-20-80 @ 1100	10-20-80 @ 1130-11..
Compound		ug/kg	ug/kg	ug/kg
dichlorodifluoromethane 2/	34334	5U	5U	5U
methyl chloride 2/	34421	5U	5U	5U
methyl bromide 2/	34416	5U	5U	5U
vinyl chloride 2/	34495	5U	5U	5U
chloroethane 2/	34314	5U	5U	5U
methylene chloride 2/	34426	5U	5U	5U
trichlorofluoromethane 2/	34491	5U	5U	5U
1,1-dichloroethylene 2/	34504	5U	5U	5U
1,1-dichloroethane 2/	34499	5U	5U	5U
1,2-trans-dichloroethylene 2/	34549	5U	5U	5U
chloroform 2/	34318	5U	5U	5U
1,2-dichloroethane 2/	34534	5U	5U	5U
1,1,1-trichloroethane 2/	34509	5U	5U	5U
carbon tetrachloride 2/	34299	5U	5U	5U
dichlorobromomethane 2/	34330	5U	5U	5U
1,2-dichloropropane 2/	34544	5U	5U	5U
1,3-dichloropropylene 2/	34564	5U	5U	5U
trichloroethylene 2/	34487	5U	5U	5U
benzene 2/	34237	5U	5U	5U
chlorodibromomethane 2/	34309	5U	5U	5U
1,1,2-trichloroethane 2/	34514	5U	5U	5U
2-chloroethyl vinyl ether (mixed) 2/	34579	5U	5U	5U
bromoform 2/	34290	5U	5U	5U
1,1,2,2-tetrachloroethane 2/	34519	5U	5U	5U
tetrachloroethylene 2/	34475	5U	5U	5U
toluene 2/	34483	5U	5U	5U
chlorobenzene 2/	34304	5U	5U	5U
ethylbenzene 2/	34374	5U	5U	5U
acrolein 2/	34213	100U	100U	100U
acrylonitrile 2/	34218	100U	100U	100U
dihydrothiophene 1/		5U	5U	8J

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1/ - Tentative identification.
2/ - On NRDC List of Priority Pollutants.

[illegible]
ATHENS, GA
4/80

SEDIMENT
DATA REPORTING SHEET
PURGEABLE ORGANIC ANALYSIS

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPLET'D 11-19-80

BASED ON WET WEIGHT BASIS

SAD NO.		81C 0103	81C 0104	81C 0105
SOURCE & STATION		IH-2 Depositional area below dump.	IH-3 Below dump ditch western side.	IH-5 composite of 4 top.
DATE/TIME		10-20-80 @ 1045	10-20-80 @ 1100	10-20-80 [illegible]
Compound		ug/kg	ug/kg	ug/kg
dichlorodifluoromethane 2/	34334	5U	5U	5U
methyl chloride 2/	34421	5U	5U	5U
methyl bromide 2/	34416	5U	5U	5U
vinyl chloride 2/	34495	5U	5U	5U
chloroethane 2/	34314	5U	5U	5U
methylene chloride 2/	34426	5U	5U	5U
trichlorofluoromethane 2/	34491	5U	5U	5U
1,1-dichloroethylene 2/	34504	5U	5U	5U
1,1-dichloroethane 2/	34499	5U	5U	5U
1,2-trans-dichloroethylene 2/	34549	5U	5U	5U
chloroform 2/	34318	5U	5U	5U
1,2-dichloroethane 2/	34534	5U	5U	5U
1,1,1-trichloroethane 2/	34509	5U	5U	5U
carbon tetrachloride 2/	34299	5U	5U	5U
dichlorobromomethane 2/	34330	5U	5U	5U
1,2-dichloropropane 2/	34544	5U	5U	5U
1,3-dichloropropylene 2/	34564	5U	5U	5U
trichloroethylene 2/	34487	5U	5U	5U
benzene 2/	34237	5U	5U	5U
chlorodibromomethane 2/	34309	5U	5U	5U
1,1,2-trichloroethane 2/	34514	5U	5U	5U
2-chloroethyl vinyl ether (mixed) 2/	34579	5U	5U	5U
bromoform 2/	34290	5U	5U	5U
1,1,2,2-tetrachloroethane 2/	34519	5U	5U	5U
tetrachloroethylene 2/	34478	5U	5U	5U
toluene 2/	34483	5U	5U	5U
chlorobenzene 2/	34304	5U	5U	5U
ethylbenzene 2/	34374	5U	5U	5U
acrolein 2/	34213	100U	100U	100U
acrylonitrile 2/	34218	100U	100U	100U
dihydrothiophene 1/		5U	5U	8.J

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1/- Tentative identification.
2/- On NRDC List of Priority Pollutants.

SEDIMENT
DATA REPORTING SHEET
PURGEABLE ORGANIC ANALYSIS

ATHENS, GA
4/80

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPLET'D. [illegible]

BASED ON WET WEIGHT BASIS

SAD NO.		81C 0106	81C 0107	
SOURCE & STATION		IH-4 Below dump northern part.	IH-7 Effluent ditch at Culvert.	
DATE/TIME		10-20-80 1120-1145	10-20-80 1125-1145	
Compound		ug/kg	ug/kg	ug/kg
dichlorodifluoromethane 2/	34334	5K	5U	
methyl chloride 2/	34421	5U	5U	
methyl bromide 2/	34416	5U	5U	
vinyl chloride 2/	34495	5U	5U	
chloroethane 2/	34314	5U	5U	
methylene chloride 2/	34426	5U	5U	
trichlorofluoromethane 2/	34491	5U	5U	
1,1-dichloroethylene 2/	34504	5U	5U	
1,1-dichloroethane 2/	34499	5U	5U	
1,2-trans-dichloroethylene 2/	34549	5U	5U	
chloroform 2/	34318	5U	5U	
1,2-dichloroethane 2/	34534	5U	5U	
1,1,1-trichloroethane 2/	34509	5U	5U	
carbon tetrachloride 2/	34299	5U	5U	
dichlorobromomethane 2/	34330	5U	5U	
1,2-dichloropropane 2/	34544	5U	5U	
1,3-dichloropropylene 2/	34564	5U	5U	
trichloroethylene 2/	34487	5U	5U	
benzene 2/	34237	5U	5U	
chlorodibromomethane 2/	34309	5U	5U	
1,1,2-trichloroethane 2/	34514	5U	5U	
2-chloroethyl vinyl ether (mixed) 2/	34579	5U	5U	
bromoform 2/	34290	5U	5U	
1,1,2,2-tetrachloroethane 2/	34519	5U	5U	
tetrachloroethylene 2/	34478	5U	5U	
toluene 2/	34483	5U	5U	
chlorobenzene 2/	34304	5U	5U	
ethylbenzene 2/	34374	5U	5U	
acrolein 2/	34213	100U	100U	
acrylonitrile 2/	34218	100U	100U	

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2/ - On NRDC List of Priority Pollutants.

- CONTINUATION -
DATA REPORTING SHEET
SEDIMENT

EPA-SAD-LSB-4-10-EC
6

PROJECT International Harvester
Memphis, TN

CHEMIST B. McDaniel REC'D 10-23-80 COMPL'D 12-17-80

PROJECT NUMBER 81-6

RESULTS ON DRY WEIGHT BASIS

SAD NO.					
SOURCE & STATION					
DATE/TIME					
ELEMENT (mg/kg)					
Aluminum	01108	23750			
Iron	01170	31050			
Manganese	01053	875			
Sodium	00934	400K			
Cyanide*(Wet Weight)	00721				
Percent Moisture (%)		33			
Asbestos *	34228	NA	NA	NA	NA

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

DATA REPORTING SHEET
SEDIMENT

EPA-SAD-LSB-4-10-[illegible]

PROJECT International Harvester Memphis, TN
CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 12-17-80

PROJECT NUMBER 81-6 RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C	0107			
SOURCE & STATION		IH-7 Eff. ditch at Culvert at field Rd. below pipe.			
DATE/TIME		10-20-80 1425-1145			
ELEMENT (mg/kg)					
Silver*	01078	3K			
Arsenic*	01003	14K			
Boron	01023				
Barium	01008	221			
Beryllium*	01013	4K			
Cadmium*	01028	4			
Cobalt	01038	8K			
Chromium*	01029	278			
Copper*	01043	37			
Molybdenum	01063	8K			
Nickel*	01068	33			
Lead*	01052	210			
Antimony*	01098	10K			
Selenium*	01148	16K			
Tin	01103	24K			
Strontium	01083	41			
Tellurium	45513	16K			
Titanium	01153	224			
Thallium*	34480	40K			
Vanadium	01088	55			
Yttrium	45514	14			
Zinc*	01093	174			
Zirconium	01163	4K			
Mercury*	71921	0.1			
Calcium	00917	6050			
Magnesium	00924	5350			

- CONTINUED ON BACK -

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

EPA, SAD, ISD
9/22/80

WATER
DATA REPORTING SHEET

SAD NO. RIC 0108 CONTRACT LAB NO. D0212 CONTRACT LAB Mead Technology
PROJECT International Harvester SOURCE & STATION [illegible]
Memphis, TN Field Road below [illegible]
DATE/TIME SAMPLED 10-20-80 @ 1420 SAMPLE RECEIVED 10-20-80 DATA RECEIVED [illegible]

VOLATILE COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L	TENTATIVELY-IDENTIFIED COMPOUNDS	ug/L
2V	Acrolein	34210	100U	The chromatogram indicates the	
3V	Acrylonitrile	34215	100U	presence of a petroleum-type	
4V	Benzene	34030	10U	product.	
6V	Carbon Tetrachloride	32102	10U		
7V	Chlorobenzene	34301	10U		
10V	1,2-Dichloroethane	32103	10U		
11V	1,1,1-Trichloroethane	34506	10U		
13V	1,1-Dichloroethane	34496	10U		
14V	1,1,2-Trichloroethane	34511	10U		
15V	1,1,2,2-Tetrachloroethane	34516	10U		
16V	Chloroethane	34311	10U		
19V	2-Chloroethylvinyl Ether	34576	10U		
23V	Chloroform	32106	10U		
29V	1,1-Dichloroethylene	34501	10U		
30V	1,2-Trans-Dichloroethylene	34546	10U		
32V	1,2-Dichloropropane	34541	10U		
33V	1,3-Dichloropropylene	34561	10U		
38V	Ethylbenzene	34371	10U		
44V	Methylene Chloride	34423	10U		
45V	Methyl Chloride	34418	10U		
46V	Methyl Bromide	34413	10U		
47V	Bromoform	32104	10U		
48V	Dichlorobromomethane	32101	10U		
49V	Trichlorofluoromethane	34488	10U		
50V	Dichlorodifluoromethane	34668	10U		
51V	Chlorodibromomethane	34306	10U		
85V	Tetrachloroethylene	34475	10U		
86V	Toluene	34010	10U		
87V	Trichloroethylene	39180	10U		
88V	Vinyl Chloride	39175	10U		

PESTICIDES/PCB'S ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
89P	Aldrin	39330	0.10U
90P	Dieldrin	39380	0.10U
91P	Chlordane (Tech. Mixture & Metabolites)	39350	0.10U
92P	4,4'-DDT (p,p'-DDT)	39300	0.10U
93P	4,4'-DDE (p,p'-DDE)	39320	0.10U
94P	4,4'-DDD (p,p'-TDE)	39310	0.10U
95P	a-Endosulfan-Alpha	34361	0.10U
96P	b-Endosulfan-Beta	34356	0.10U
97P	Endosulfan Sulfate	34351	0.10U
98P	Endrin	39390	0.10U
99P	Endrin Aldehyde	34366	0.10U
100P	Heptachlor	39410	0.10U
101P	Heptachlor Epoxide	39420	0.10U
102P	a-BHC-Alpha	39337	0.10U
103P	b-BHC-Beta	39338	0.10U
104P	γ-BHC-(Lindane)-Gamma	39340	0.10U
105P	δ-BHC-Delta	34259	0.10U
106P	PCB-1242 (Aroclor 1242)	39496	0.10U
107P	PCB-1254 (Aroclor 1254)	39504	0.10U
108P	PCB-1221 (Aroclor 1221)	39488	0.10U
109P	PCB-1232 (Aroclor 1232)	39492	0.10U
110P	PCB-1248 (Aroclor 1248)	39500	0.10U
111P	PCB-1260 (Aroclor 1260)	39508	0.15U
112P	PCB-1016 (Aroclor 1016)	34671	0.10U
113P	Toxaphene	39400	0.40U
129P	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	34675	NA

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.

8/22/80

WATER
DATA REPORTING SHEET

SAD NO. 81CD10B CONTRACT LAB NO. DO212 CONTRACT LAB Mead Technology
PROJECT International Harvester SOURCE & STATION IH-6 EFF. Ditch a. Culvert at
Memphis, TN Field Road below pipe.
DATE/TIME SAMPLED 10-20-80 @ 1420 SAMPLE RECEIVED 10-20-80 DATA RECEIVED 12-17-80

BASE/NEUTRAL COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
1B	Acenaphthene	34205	10U
5B	Benzidine	39120	10U
8B	1,2,4-Trichlorobenzene	34551	10U
9B	Hexachlorobenzene	39700	10U
12B	Hexachloroethane	34396	10U
17B	Bis(Chloromethyl) Ether	34269	NA
18B	Bis(2-Chloroethyl) Ether	34273	10U
20B	2-Chloronaphthalene	34581	10U
25B	1,2-Dichlorobenzene	34536	10U
26B	1,3-Dichlorobenzene	34566	10U
27B	1,4-Dichlorobenzene	34571	10U
28B	3,3'-Dichlorobenzidine	34631	10U
35B	2,4-Dinitrotoluene	34611	10U
36B	2,6-Dinitrotoluene	34626	10U
37B	1,2-Diphenylhydrazine 1/	34346	10U
39B	Fluoranthene	34376	10U
40B	4-Chlorophenyl Phenyl Ether	34641	10U
41B	4-Bromophenyl Phenyl Ether	34636	10U
42B	Bis(2-Chloroisopropyl) Ether	34283	10U
43B	Bis(2-Chloroethoxy) Methane	34278	10U
52B	Hexachlorobutadiene	39702	10U
53B	Hexachlorocyclopentadiene	34386	10U
54B	Isophorone	34408	10U
55B	Naphthalene	34696	10U
56B	Nitrobenzene	34447	10U
61B	N-Nitrosodimethylamine 2/	34438	NA
62B	N-Nitrosodiphenylamine 2/	34433	10U
63B	N-Nitrosodi-N-Propylamine	34428	10U
66B	Bis(2-Ethylhexyl) Phthalate	39100	50U
67B	Butyl Benzyl Phthalate	34292	10U
68B	Di-N-Butylphthalate	39110	10U
69B	Di-N-Octylphthalate	34596	10U
70B	Diethylphthalate	34336	10U
71B	Dimethylphthalate	34341	10U
72B	Benzo (A) Anthracene 3/	34526	10U
73B	Benzo(A) Pyrene	34247	10U
74B	3,4-Benzofluoranthene 3/	34230	10U
75B	Benzo(K) Fluoranthene 3/	34242	10U
76B	Chrysene 3/	34320	10U
77B	Acenaphthylene	34200	10U
78B	Anthracene 3/	34220	10U
79B	Benzo(GHI) Perylene	34521	25U
80B	Fluorene	34381	10U
81B	Phenanthrene 3/	34461	10U
82B	Dibenzo(A, H) Anthracene	34556	25U
83B	Indeno (1,2,3-CD) Pyrene	34403	25U
84B	Pyrene	34469	25U

ACID COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
21A	2,4,6-Trichlorophenol	34621	25U
22A	p-Chloro-m-Cresol	34452	25U
24A	2-Chlorophenol	34586	25U
31A	2,4-Dichlorophenol	34601	25U
34A	2,4-Dimethylphenol	34606	25U
57A	2-Nitrophenol	34591	25U
58A	4-Nitrophenol	34646	25U
59A	2,4-Dinitrophenol	34616	250U
60A	4,6-Dinitro-o-Cresol	34657	250U
64A	Pentachlorophenol	39032	25U
65A	Phenol (GC/MS)	34694	25U

K - Actual value is known to be less than value given.
U - Material was analyzed for but not detected. The number is the minimum detection limit.
1/ - And/or Azobenzene.
2/ - And/or Diphenylamine.
3/ - 81B Phenanthrene and/or 78B Anthracene.

DATA REPORTING SHEET
WATER

EPA-SAD-LSB 4-10-80

PROJECT International Harvester CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 11-20-80
Memphis, TN
PROJECT No. 81-6

SAD NO. 81- C	0103			
SOURCE & STATION	IH-6 EFF Ditch at Culvert and Field Rd. Below Pipe.			
DATE/TIME	10-20-80 @ 1420-1145			
ELEMENT (ug/L)				
Silver * 01077	10K			
Arsenic * 01002	45K			
Boron 01022	---			
Barium 01007	41			
Beryllium * 01012	10K			
Cadmium * 01027	10K			
Cobalt 01037	20K			
Chromium * 01034	104			
Copper * 01042	14			
Molybdenum 01062	215			
Nickel * 01067	35K			
Lead * 01051	40K			
Antimony * 01097	25K			
Selenium * 01147	40K			
Tin 01102	60K			
Strontium 01082	44			
Tellurium 01064	40K			
Titanium 01152	10K			
Thallium * 01059	100K			
Vanadium 01087	10K			
Yttrium 01203	10K			
Zinc * 01092	---			
Zirconium 01162	10K			
Mercury * 71900	0.2K			
Aluminum 01105	300			
Manganese 01055	50K			

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

(Continued on Back)

DATA REPORTING SHEET
WATER

PROJECT International Harves[illegible] Memphis, TN CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 11-20

PROJECT No. 81-6

SAD NO. SIC	0108			
SOURCE & STATION	IH-6 EFF Ditch at Cluvert and Field Rd. below pipe.			
DATE/TIME	10-20-80 @ 1420-1145			
ELEMENT (mg/L)				
Calcium 00916	13			
Magnesium 00927	5.9			
Iron 74010	1.0			
Sodium 00929	17			
Cyanide * 00720				
Asbestos * 34225	NA	NA	NA	NA

K – Actual value is known to be less than value given.
L – Actual value is known to be greater than value given.
* – Priority Pollutant.

DATA REPORTING SHEET
WATER

[illegible]

PROJECT International Harvester — Memphis, TN CHEMIST B. McDaniel REC'D 10-21-80 COMPL'D 11-20-80

PROJECT No. 81-6

SAD NO. 81C	0150			
SOURCE & STATION	IH-001 NPDES Outfall in ditch downstream.			
DATE/TIME	10-21-80 @ 0935			
ELEMENT (ug/L)				
Silver * 01077	10K			
Arsenic * 01002	45K			
Boron 01022	---			
Barium 01007	38			
Beryllium * 01012	10K			
Cadmium * 01027	10K			
Cobalt 01037	20K			
Chromium * 01034	58			
Copper * 01042	11			
Molybdenum 01062	68			
Nickel * 01067	35K			
Lead * 01051	40K			
Antimony * 01097	25K			
Selenium * 01147	40K			
Tin 01102	60K			
Strontium 01082	38			
Tellurium 01064	40K			
Titanium 01152	10K			
Thallium * 01059	100K			
Vanadium 01087	10K			
Yttrium 01203	10K			
Zinc * 01092	---			
Zirconium 01162	10K			
Mercury * 71900	0.2K			
Aluminum 01105	154			
Manganese 01055	50K			

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

DATA REPORTING SHEET
WATER

PROJECT ______ CHEMIST B. McDaniel REC'D 10-21-80 COMPL'D 11-20

Memphis, TN
PROJECT No. 81-6

SAD NO. 81C	0150			
SOURCE & STATION	TH-001 NPDES Outfall in ditch downstream.			
DATE/TIME	10-21-80 @ 0935			
ELEMENT (mg/L)				
Calcium 00916	13			
Magnesium 00927	6.0			
Iron 74010	0.6			
Sodium 00929	12			
Cyanide * 00720				
Asbestos * 34225	NA	NA	NA	NA

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

US EPA REGION IV SAA DIVISION
LABORATORY SERVICES BRANCH
DATA REPORTING SHEET
81C0103 - 81C0100

...RNATIONAL HARVESTER

PROJECT # 81-6 ***PROG ELEMENT # CSI

...PHIS STATE: TN

SAMPLE RECEIVED DATE & 10/20/80 1530

COMPLETED: 11/13/8...

STATION	DATE & TIME SAMPLED	SAMPLE TYPE	HG UG/L	METSC	CN MG/L	TOC MG/L	PH PH	TEM DEG C
IH-6 EFF DITCH @ CULVERT & FIELD RD BELOW PIPE	10/20/80- 1420- 10/20/80 1145	AMBWA			.002K	15.0	6.4	25.0

ATTACHMENT 2

U.S. ENVIRONMENTAL PROTECTION AGENCY

SURVEILLANCE AND ANALYSIS DIVISION

REGION IV

ATHENS, GEORGIA

DISCHARGER International Harvester

ADDRESS Memphis TN

CONTACT

SAMPLING STATION NO. IH-001

SAMPLING LOCATION NPDES outfall 001 in ditch downstream [illegible] [illegible] [illegible]

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☑ IND. ☐ INF. ☑ EFF. ☐ ______ ☑ 24 HR. COMP. AT 30 MIN. INTERVALS ☐ FLOW PRO

SAMPLER ☑ EPA ☐ DISCHARGER ☐ MAN. ☑ AUTO. ☑ TYPE ISCO 1680 # 180022 (.30)

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ______ EQUIP ______

COMPUTED FROM ______

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.	0150	0150				BACTERIAL	0
DATE	10/20/80 10/21/80	10/21/80				BOD, COD, TOC	1
TIME	1000 1000	0935				CYANIDE	2
FLOW (MGD) [1]	1.44					METALS	3
TEMPERATURE °C		25				N, P	4
pH		7.3				ORG, O&G, PEST	5
TOT. Cl_2 RES, mg/l						PHENOLS	6
						SOLIDS	7
SAMPLE CODE	←	3c metals					8
SAMPLED BY (Sig)		BSK, LATH					9
SEALED BY (Sig)		BSK					A
DATE AND TIME		10/21/80 1030					B
						PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs

[2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
[illegible]	10/21/80	1030	1		

REMARKS AND SKETCHES

G-1 - 1pt glass metals

pH meter calibrated @ 7.0 reads [illegible] on 4 [illegible] on 10

PH Buffer

4 4.2

7 6.8

10 9.4

1,440,000 gal / 24 hr period

GPO 1970-640-138 / 1969, REGION NO. 4

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester	SAMPLING STATION NO. IH-2
ADDRESS Memphis, TN	SAMPLING LOCATION Deposition at area below southern outlet part of dump
CONTACT Gene Cuttrell	

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT SAMPLE HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO

SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ____

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP ____

COMPUTED FROM ____

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0103				BACTERIAL	
DATE	/	10/20/80				BOD, COD, TOC	
TIME	/	1045				CYANIDE	
FLOW ( ) [1]						METALS	
TEMPERATURE °C						N, P	
pH						ORG, OBG, PEST	
TOT. Cl2 RES, mg/l						PHENOLS	
						SOLIDS	
SAMPLE CODE		See below					
SAMPLED BY (Sig)		[illegible]					
SEALED BY (Sig)		[illegible]					
DATE AND TIME		10/20/80 1100				PRESERVED	

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs — [2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO CART.	RECEIPT NO.
Fed. Express	10/20/80	15:30	2		

REMARKS AND SKETCHES

1-1qt glass - organics < ext. Q / vol. R

1-1pt ~~glass~~ plastic - metals R

- dup. metals sample collected for IH; ~~see separate~~ ~~sheet~~

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV

ATHENS, GEORGIA

DISCHARGER International Harvester

ADDRESS

Memphis, TN

CONTACT

SAMPLING STATION NO. IH-3

SAMPLING LOCATION Depositional area below drainage ditch [illegible] on western side of site

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.

SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ____

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP ____

COMPUTED FROM ____

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES			
SAD NO.		0104			
DATE		10/20/80			
TIME		1100			
FLOW ( ) [1]					
TEMPERATURE °C					
pH					
TOT. Cl_2 RES, mg/l					
SAMPLE CODE		See below			
SAMPLED BY (Sig)		[illegible]			
SEALED BY (Sig)		[illegible]			
DATE AND TIME		10/20/80 1200			

SAMPLE CODE [2]	
BACTERIAL	0
BOD, COD, TOC	1
CYANIDE	2
METALS	3
N, P	4
ORG, O&G, PEST	5
PHENOLS	6
SOLIDS	7
	8
	9
	A
	B
PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs

[2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
[illegible]	10/30/80	13:30	2		

REMARKS AND SKETCHES

1 - 1qt glass - organics < ext F / vol F

1 - 1pt plastic - metals F (metals dupl. collected for IH)

GPO 1980 - 640-158 / 1988, REGION NO. 4

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester	SAMPLING STATION NO. IH-4
ADDRESS	SAMPLING LOCATION [illegible]
Memphis TN	[illegible]
CONTACT [illegible]	[illegible]

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ ___ HR. COMP AT ___ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ___ EQUIP
COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES			SAMPLE CODE [2]	
SAD NO.		0106			BACTERIAL	0
DATE	/ /	10/20/80			BOD, COD, TOC	1
TIME	/ /	1120			CYANIDE	2
FLOW ( ) [1]					METALS	3
TEMPERATURE °C					N, P	4
pH					ORG, OOG, PEST	5
TOT. Cl2 RES, mg/l					PHENOLS	6
					SOLIDS	7
						8
SAMPLE CODE		[illegible]				9
SAMPLED BY (Sig)		[illegible]				A
SEALED BY (Sig)		[illegible]				B
DATE AND TIME	/	10/20/80 1120			PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs
[2] Circle or indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
[illegible]	10/20/80	15:30	2		

REMARKS AND SKETCHES

1 - 1qt glass - organics < ext. ✓ / VOA ✓
1 - 1pt plastic - metals ✓ (dupl metals collected for IH)

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis TN
CONTACT [illegible]

SAMPLING STATION NO. IH-3
SAMPLING LOCATION Composite of Several (4) Locations on site from top of dump

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ ___ HR. COMP. AT ___ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ___
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ___ EQUIP ___
COMPUTED FROM ___

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES			
SAD NO.		0107			
DATE		10/20/80			
TIME		1130-1145			
FLOW ( ) [1]					
TEMPERATURE °C					
pH					
TOT. Cl2 RES. mg/l					
SAMPLE CODE		[illegible]			
SAMPLED BY (Sig)		[illegible]			
SEALED BY (Sig)		[illegible]			
DATE AND TIME		10-12-80 1300			

SAMPLE CODE [2]	
BACTERIAL	0
BOD, COD, TOC	1
CYANIDE	2
METALS	3
N, P	4
ORG, O&G, PEST	5
PHENOLS	6
SOLIDS	7
	8
	9
	A
	B
PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs
[2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
[illegible]	10/20/80	13:20	2		

REMARKS AND SKETCHES

1- "lower pile" - 1130
2- "upper pile" - 1140
3- " " 1142
4- " " 1145
1- 1qt glass - organic (ext P / VOA P
1- 1pt plastic - metals P (dupl. metals collected for IH)

U.S. ENVIRONMENTAL PROTECTION   D 0212
SURVEILLANCE AND ANALYSIS D

REGION IV   ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis TN
CONTACT [illegible]

SAMPLING STATION NO. IH-6
SAMPLING LOCATION Effluent ditch Culvert [illegible] road [illegible] outlow discharge (NPDES) pipe

SAMPLE AND WASTE FLOW INFORMATION

WATER

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ ____ ☐ ____ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.

SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO ☐ TYPE ____

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP ____

COMPUTED FROM ____

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0168				BACTERIAL	0
DATE		10/20/80				BOD, COD, TOC	1
TIME		1420				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C		25.0				N, P	4
pH		6.4				ORG, OAG, PEST	5
TOT. Cl_2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		[illegible]					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME		10/20/80 1520				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs   [2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
B. T. [illegible]	10/20/80	1534	5		

REMARKS AND SKETCHES

D-0212

1 - 1 gal glass - organics
1 - 1 pt glass - metals   - metals dupl. collected for I H
1 - VIAL - VOA
1 - ½ gal plastic - CN
1 - TOC

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis, TN
CONTACT [illegible]

SAMPLING STATION NO. IH-7
SAMPLING LOCATION [illegible]

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP
COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0137				BACTERIAL	0
DATE		10/22/80				BOD, COD, TOC	1
TIME		1425				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, OBG, PEST	5
TOT. Cl_2 RES. mg/l						PHENOLS	6
						SOLIDS	7
SAMPLE CODE		[illegible]					8
SAMPLED BY (Sig)		[illegible]					9
SEALED BY (Sig)		[illegible]					A
DATE AND TIME		[illegible] 1500					B
						PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs   [2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
[illegible]	10/22/80	15:30	2		

REMARKS AND SKETCHES

1 - 1 qt glass - organics - VOA P ext. P
1 - pt plastic - metals P (dupl. metals collected for IH)

SUPPLEMENTAL REPORT
HAZARDOUS WASTE SITE INVESTIGATION
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE
APRIL 29, 1981

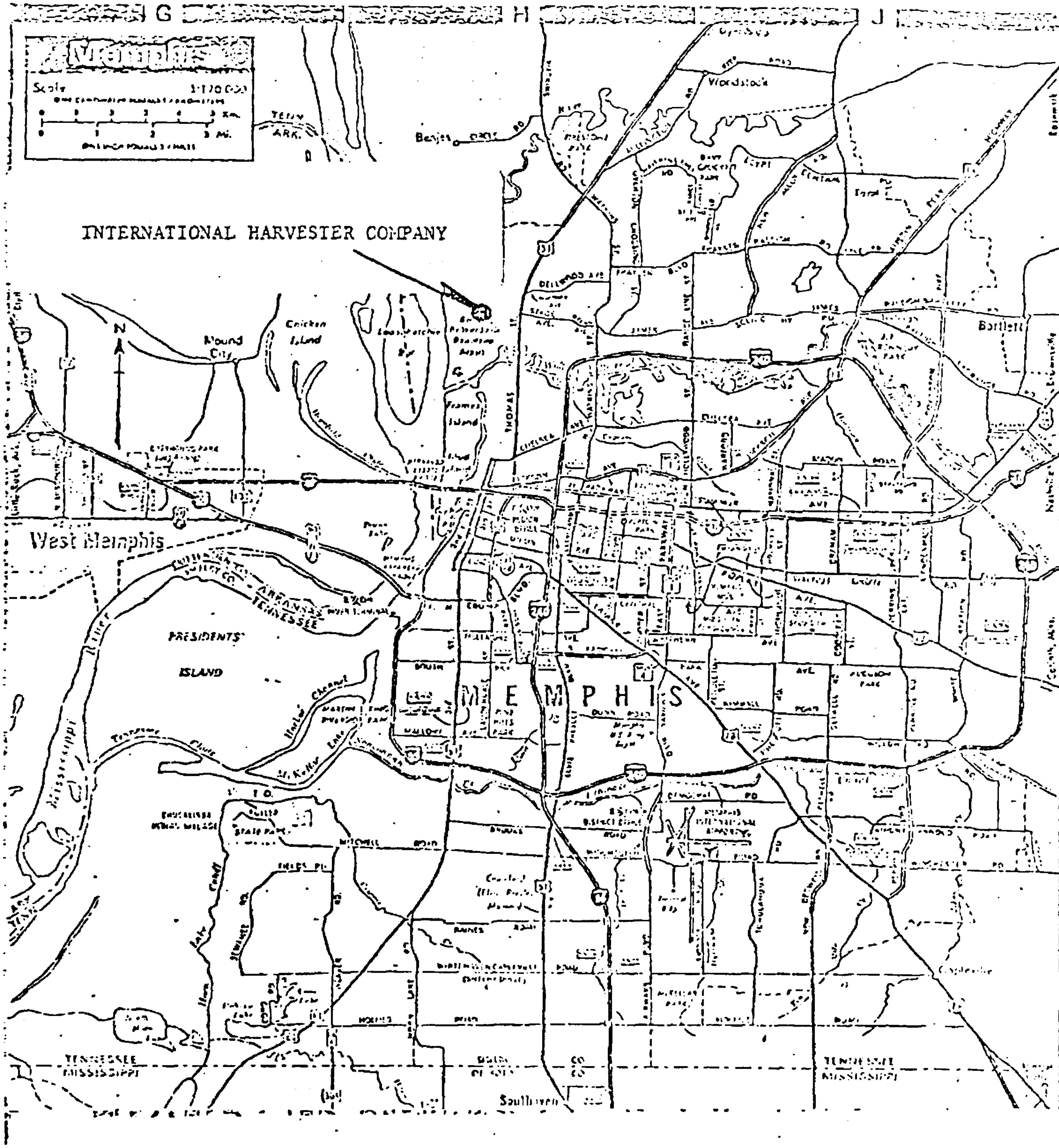
A hazardous waste site investigation report for International Harvester Company was issed April 7, 1981, by the U. S. Environmental Protection Agency, Surveillance and Analysis Division (SAD). At the time the report was issued, cyanide data were not available for the soil and sediment samples collected at the International Harvester Company. Cyanide analyses were reported on April 20, 1981, by the Laboratory Services Branch. These data are included in Table 1; general site location and sampling locations are included in Figures 1 and 2.

The cyanide concentration in sediment sample IH-3 (0.68 mg/kg) collected at the southern portion of the landfill appears to be higher than the concentrations in the other soil and sediment samples. The sediment sample (IH-7) taken from the drainage ditch that carries runoff to the Mississippi River contained a concentration of 0.27 mg/kg. The water sample (IH-6) contained a trace concentration (<.002 mg/l) but was too low to be quantified (see April 7, 1981 report).

TABLE 1
CYANIDE CONCENTRATIONS IN SOIL AND SEDIMENT SAMPLES
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

Sample Number	Location	Cyanide Concentration mg/kg (dry weight)
IH-2	Depositional area below the southern most part of landfill	0.68
IH-3	Depositional area below landfill in drainage ditch on western side of landfill	0.25
IH-4	Area below landfill on northern part of dump	0.37
IH-5	Composite sample collected on top of landfill	0.21
IH-7	Effluent and drainage ditch at culvert and field road	0.27

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE



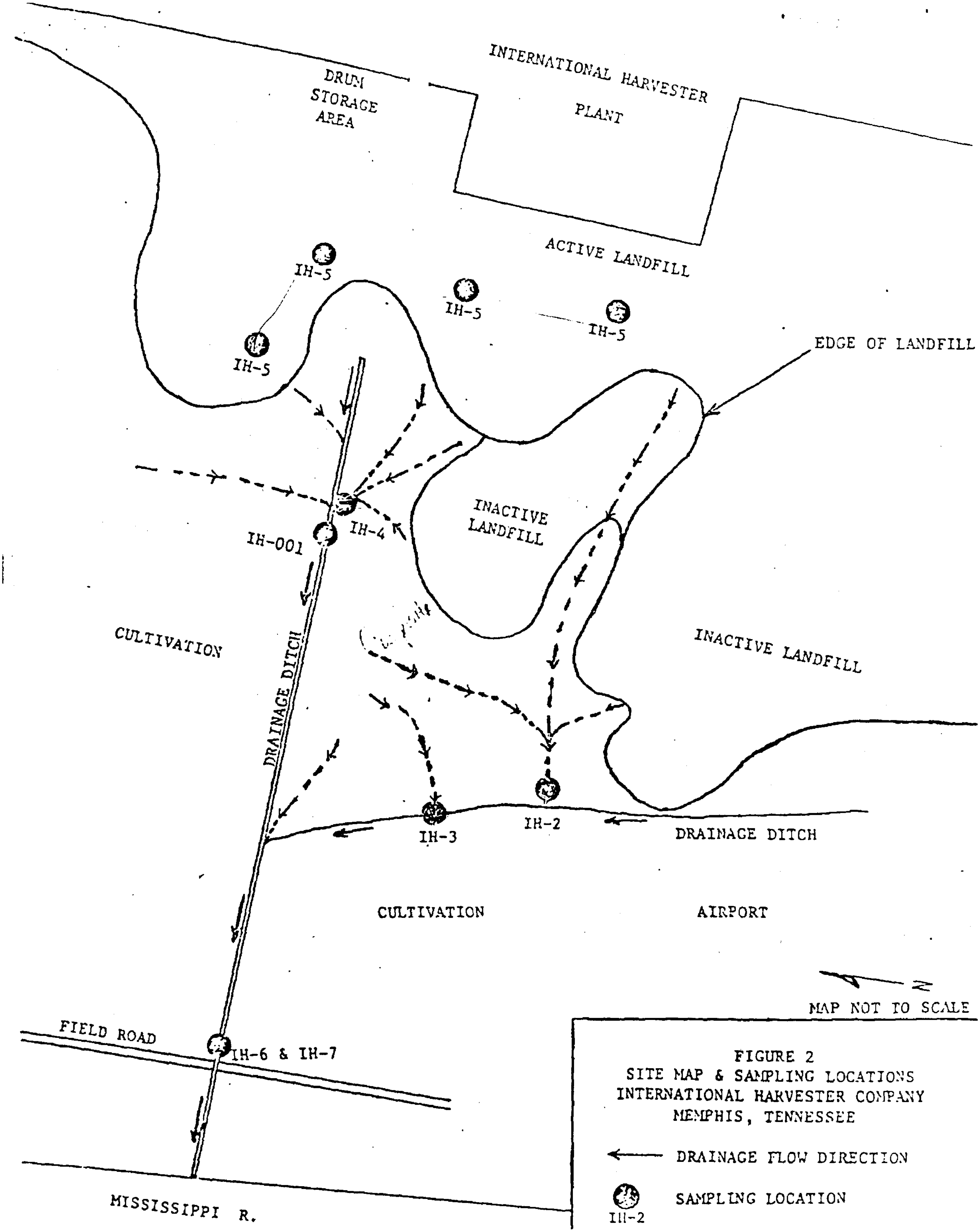


FIGURE 2
SITE MAP & SAMPLING LOCATIONS
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

Reference 13

Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States

By HANSFORD T. SHACKLETTE *and* JOSEPHINE G. BOERNGEN

U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER 1270

An account of the concentrations of 50 chemical elements in samples of soils and other regoliths

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1984

1, unlike the geometric means shown in table 2, are estimates of geochemical abundance (Miesch, 1967). Arithmetic means are always larger than corresponding geometric means (Miesch, 1967, p. B1) and are estimates of the fractional part of a single specimen that consists of the element of concern rather than of the typical concentration of the element in a suite of samples.

Concentrations of 46 elements in samples of this study are presented in table 2, which gives the determination ratios, geometric-mean concentrations and deviations, and observed ranges in concentrations. The analytical data for most elements as received from the laboratories were transformed into logarithms because of the tendency for elements in natural materials, particularly the trace elements, to have positively skewed

TABLE 2.—*Mean concentrations, deviations, and ranges of elements in samples of soils and other surficial materials in the conterminous United States*

[Means and ranges are reported in parts per million (µg/g), and means and deviations are geometric except as indicated. Ratio, number of samples in which the element was found in measurable concentrations to number of samples analyzed. <, less than; >, greater than]

Element	Conterminous United States			Western United States (west of 96th meridian)					Eastern United States (east of 96th meridian)				
	Mean	Deviation	Estimated arithmetic mean	Ratio	Mean	Deviation	Observed range	Estimated arithmetic mean	Ratio	Mean	Deviation	Observed range	Estimated arithmetic mean
Al, percent	4.7	2.48	7.2	661:770	5.8	2.00	0.5 - >10	7.4	450:477	3.3	2.87	0.7 - >10	5.7
As	5.2	2.23	7.2	728:730	5.5	1.98	<0.10 - 97	7.0	521:527	4.8	2.56	<0.1 - 73	7.4
B	26	1.97	33	506:778	23	1.99	<20 - 300	29	425:541	31	1.88	<20 - 150	38
Ba	440	2.14	580	778:778	580	1.72	70 - 5,000	670	541:541	290	2.35	10 - 1,500	420
Be	.63	2.38	.92	310:778	.68	2.30	<1 - 15	.97	169:525	.55	2.53	<1 - 7	.85
Br	.56	2.50	.85	113:220	.52	2.74	<0.5 - 11	.86	78:128	.62	2.18	<0.5 - 5.3	.85
C, percent	1.6	2.57	2.5	250:250	1.7	2.37	0.16 - 10	2.5	162:162	1.5	2.88	0.06 - 37	2.6
Ca, percent	.92	4.00	2.4	777:777	1.8	3.05	0.06 - 32	3.3	514:514	.34	3.08	0.01 - 28	.63
Ce	63	1.78	75	81:683	65	1.71	<150 - 300	75	70:489	63	1.85	<150 - 300	76
Co	6.7	2.19	9.1	698:778	7.1	1.97	<3 - 50	9.0	403:533	5.9	2.57	<0.3 - 70	9.2
Cr	37	2.37	54	778:778	41	2.19	3 - 2,000	56	541:541	33	2.60	1 - 1,000	52
Cu	17	2.44	25	778:778	21	2.07	2 - 300	27	523:533	13	2.80	<1 - 700	22
F	210	3.34	430	598:610	280	2.52	<10 - 1,900	440	390:435	130	4.19	<10 - 3,700	360
Fe, percent	1.8	2.38	2.6	776:777	2.1	1.95	0.1 - >10	2.6	539:540	1.4	2.87	0.01 - >10	2.5
Ga	13	2.03	17	767:776	16	1.68	<5 - 70	19	431:540	9.3	2.38	<5 - 70	14
Ge	1.2	1.37	1.2	224:224	1.2	1.32	0.58 - 2.5	1.2	130:131	1.1	1.45	<0.1 - 2.0	1.2
Hg	.058	2.52	.089	729:733	.046	2.33	<0.01 - 4.6	.065	534:534	.081	2.52	0.01 - 3.4	.12
I	.75	2.63	1.2	169:246	.79	2.55	<0.5 - 9.6	1.2	90:133	.68	2.81	<0.5 - 7.0	1.2
K, percent[1]	1.5	.79	None	777:777	1.8	.71	0.19 - 6.3	None	537:537	1.2	.75	0.005 - 3.7	—
La	30	1.92	37	462:777	30	1.89	<30 - 200	37	294:516	29	1.98	<30 - 200	37
Li	20	1.85	24	731:731	22	1.58	5 - 130	25	479:527	17	2.16	<5 - 140	22
Mg, percent	.44	3.28	.90	777:778	.74	2.21	0.03 - >10	1.0	528:528	.21	3.55	0.005 - 5	.46
Mn	330	2.77	550	777:777	380	1.98	30 - 5,000	480	537:540	260	3.82	<2 - 7,000	640
Mo	.59	2.72	.97	57:774	.85	2.17	<3 - 7	1.1	32:524	.32	3.93	<3 - 15	.79
Na, percent	.59	3.27	1.2	744:744	.97	1.95	0.05 - 10	1.2	363:449	.25	4.35	<0.05 - 5	.78
Nb	9.3	1.75	11	418:771	8.7	1.82	<10 - 100	10	322:498	10	1.65	<10 - 50	12
Nd	40	1.65	46	120:538	36	1.76	<70 - 300	43	109:332	46	1.58	<70 - 300	51
Ni	13	2.31	19	747:778	15	2.10	<5 - 700	19	463:540	11	2.64	<5 - 700	18
P	260	2.67	430	524:524	320	2.33	40 - 4,500	460	380:382	200	2.95	<20 - 6,800	360
Pb	16	1.86	19	712:778	17	1.80	<10 - 700	20	422:541	14	1.95	<10 - 300	17
Rb	58	1.72	67	221:224	69	1.50	<20 - 210	74	107:131	43	1.94	<20 - 160	53
S, percent	.12	2.04	.16	34:224	.13	2.37	<0.08 - 4.8	.19	20:131	.10	1.34	<0.08 - 0.31	.11
Sb	.48	2.27	.67	35:223	.47	2.15	<1 - 2.6	.62	31:131	.52	2.38	<1 - 8.8	.76
Sc	7.5	1.82	8.9	685:778	8.2	1.74	<5 - 50	9.6	389:526	6.5	1.90	<5 - 30	8.0
Se	.26	2.46	.39	590:733	.23	2.43	<0.1 - 4.3	.34	449:534	.30	2.44	<0.1 - 3.9	.45
Si, percent[1]	31	6.48	None	250:250	30	5.70	15 - 44	None	156:156	34	6.64	1.7 - 45	—
Sn	.89	2.36	1.3	218:224	.90	2.11	<0.1 - 7.4	1.2	123:131	.86	2.81	<0.1 - 10	1.5
Sr	120	3.30	240	778:778	200	2.16	10 - 3,000	270	501:540	53	3.61	<5 - 700	120
Ti, percent	.24	1.89	.29	777:777	.22	1.78	0.05 - 2.0	.26	540:540	.28	2.00	0.007 - 1.5	.35
Th	8.6	1.53	9.4	195:195	9.1	1.49	2.4 - 31	9.8	102:102	7.7	1.58	2.2 - 23	8.6
U	2.3	1.73	2.7	224:224	2.5	1.45	0.68 - 7.9	2.7	130:130	2.1	2.12	0.29 - 11	2.7
V	58	2.25	80	778:778	70	1.95	7 - 500	88	516:541	43	2.51	<7 - 300	66
Y	21	1.78	25	739:778	22	1.66	<10 - 150	25	477:541	20	1.97	<10 - 200	25
Yb	2.6	1.79	3.1	734:764	2.6	1.63	<1 - 20	3.0	452:486	2.6	2.06	<1 - 50	3.3
Zn	48	1.95	60	766:766	55	1.79	10 - 2,100	65	473:482	40	2.11	<5 - 2,900	52
Zr	180	1.91	230	777:778	160	1.77	<20 - 1,500	190	539:541	220	2.01	<20 - 2,000	290

[1] Means are arithmetic, deviations are standard.

Reference 14

PICKERING
WOOTEN
SMITH
WEISS, INC.
ENGINEERING AND PLANNING

JUL 27 1984

July 18, 1984

Mr. Danny Brewer
Environmental Engineer, Superfund
Division of Solid Waste Management
Department of Health and Environment
295 Summar Avenue
Jackson, Tennessee 38301

Dear Mr. Brewer:

Enclosed with this letter is a copy of the laboratory analyses of water and soil samples collected at the International Harvester landfill near Harvester Lane in North Memphis. These samples were collected on June 15, 1984 under my personal supervision.

The sampling locations and methods of collection and analyses were in accordance with our letter to you dated June 11, 1984.

In addition, we analyzed the two water samples "A" and "B" for phenol.

As stated in the June 11, 1984 letter, the sampling locations were as follows:

Sample	1980 EPA Investigation Sample Number	Description
A	1	Water from NPDES outfall.
B	6	Water 1000 ft. below NPDES outfall.
C	2 3 4	Sediment samples below landfill. To be composited into one sample.
D	5	Composite of 4 soil samples from top of landfill.
E	7	Sediment from same location as water sample B.
F	-	Sediment from 3 new sites in the cultivated area below the landfill. To be composited into one sample.

Sample	1980 EPA Investigation Sample Number	Description
G	-	Soil from 3 new sites in adjacent property proposed as cover material. To be composited into one sample.
H	5	Duplicated of sample D for quality assurance.

It appears that the test results from sites A thru E and H are similar to the EPA results. The new sites F and G were quite "clean". Based on these results, we propose to move forward with our proposal to reshape and close the landfill.

Please review these results and schedule a meeting so we can proceed with plans for closing the landfill.

Very truly yours,

PICKERING·WOOTEN·SMITH·WEISS, INC.

Sheldon Kelman

Sheldon Kelman, Ph.D., P.E.

SK:mt

Enclosure

cc: Mr. Gene Cutrell, International Harvester

SAMPLE IDENTIFIER: Pickering, Wooten, Smit & Weiss, Inc.

AWARE SAMPLE NO.: 9020

DATE RECEIVED: June 18, 1984

EP TOXICITY EXTRACTS

Report #02381

ANALYSIS	"A"	"B"	"C"	"D"	"E"	"F"	"G"	"H" duplicate
Al	<0.2	<0.2	2.6	0.9	0.6	0.4	0.4	1.5
Ba	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.5
Cd	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cr	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cu	<0.02	<0.02	1.37	<0.02	<0.02	<0.02	<0.02	0.03
Fe	<0.05	<0.05	0.20	0.05	<0.05	0.08	0.08	0.10
Pb	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Hg	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Ni	<0.03	<0.03	11.3	<0.03	0.07	0.05	<0.03	0.05
Zn	0.05	<0.02	0.19	0.04	0.27	0.06	0.58	0.06

EXTRACTABLE ORGANICS

ANALYSIS	"A"	"B"	"C"	"D"	"E"	"F"	"G"	dup. "H"
Phenol	<0.05	<0.05	<0.5	<0.5	<0.5	<0.5	<0.5	1.4
Pesticide Scan(BHC)	<0.01	<0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
(DDT)	<0.01	<0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
(DDE)	<0.01	<0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
(Endrin)	<0.01	<0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
(Aldrin)	<0.01	<0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
(Heptachlor)	<0.01	<0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
PCB Scan (1254)	<0.01	<0.01	1.4	1.2	2.8	<0.5	<0.5	4.1
PCB Scan (1248)	<0.01	<0.01	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
POLYNUCLEAR AROMATIC HYDROCARBON SCAN								
(Naphthalene)	<0.05	<0.05	<1	<1	<1	<1	<1	<1
(Phenanthrene)	<0.05	<0.05	<1	<1	<1	<1	<1	<1
(Anthracene)	<0.05	<0.05	<1	<1	<1	<1	<1	<1
(Fluoranthene)	<0.05	<0.05	<1	<1	<1	<1	<1	<1
(Pyrene)	<0.05	<0.05	<1	<1	<1	<1	<1	<1
(3,4-benzopyrene)	<0.05	<0.05	<1	<1	<1	<1	<1	<1
(1,2-benzanthracene)	<0.05	<0.05	<1	<1	<1	<1	<1	<1

Results are expressed in ppm.

Pickering Environmental Consultants, Inc.

Asbestos Management
Building Site Evaluation

September 20, 1989

Mr. Jordan English
Geologist, TDSF
Department of Health and Environment
295 Summar Avenue
Memphis, Tennessee 38301-3984

Re: Harvester Landfill - Memphis

Dear Mr. English:

I have surveyed the four monitoring wells at the Harvester Landfill per your request of September 7, 1989. The attached table shows dates of monitoring, well casing elevations and groundwater levels. As can be seen, Well Numbers 1, 2 and 3 have descending water elevations. This can be accounted for by the ditch which is closest to Well Number 3. Well Number 4 apparently has a different drainage pattern and has a higher groundwater elevation.

In any event, Well Number 1 is higher than Numbers 2 and 3 and can be considered a background well.

We do not know the source of the chromium in Well Number 1. It did not show up in the early monitoring tests and may be a transient that will decrease with time. In any event, it is on the City's property, not Navistar's. It does not appear to be Navistar's problem. In addition, this level of chromium is within the proposed state limits for fishing and recreational water.

Please let me know if you have any questions regarding this letter.

Very truly yours,

PICKERING ENVIRONMENTAL CONSULTANTS, INC.

Sheldon Kelman, Ph.D., P.E.
Director/Environmental Engineering

SK:mt

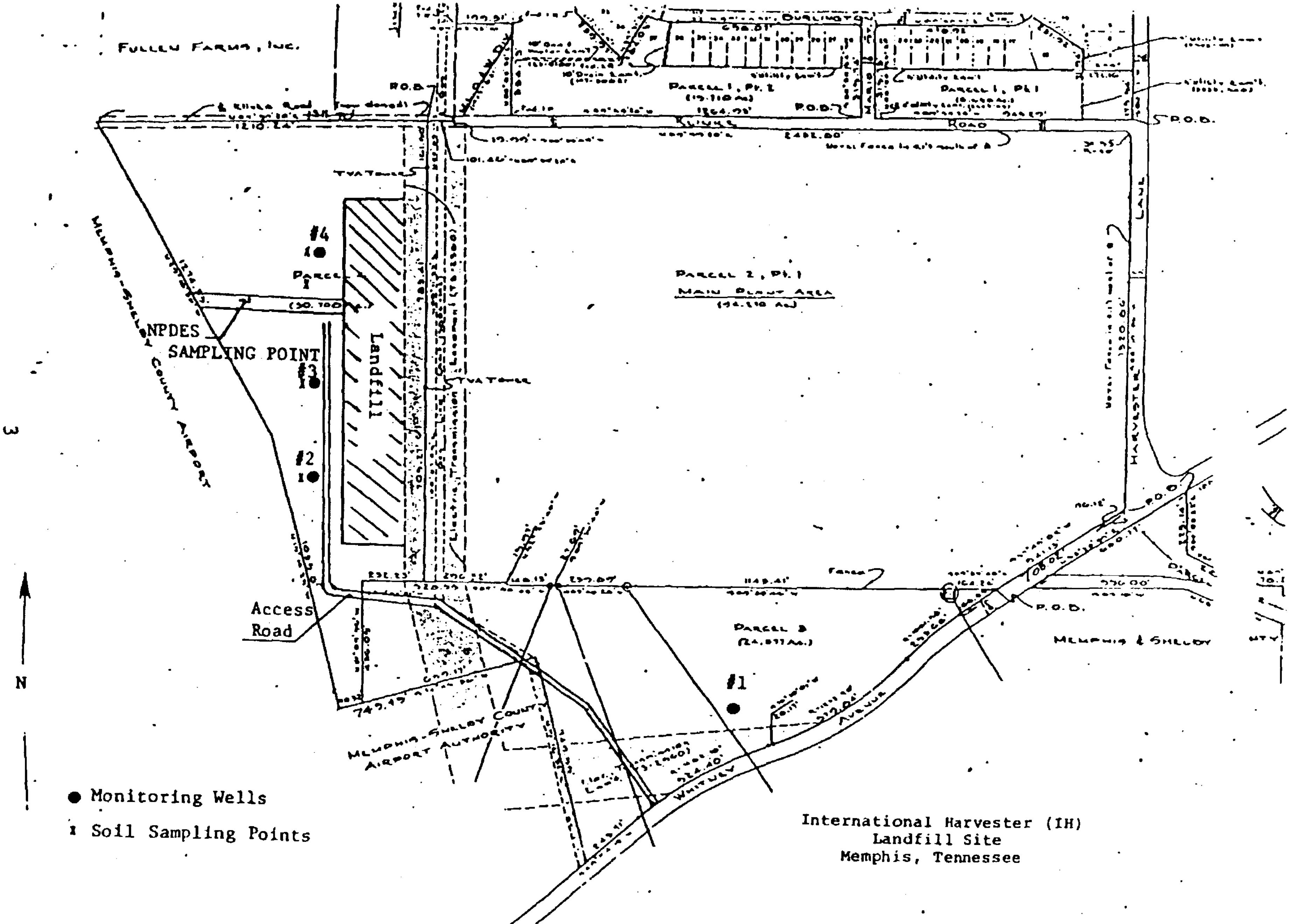
cc: Edith Ardiente - Navistar

FILE:WELLS

COMPARISON OF HARVESTER WELL READINGS

	WELL NO.1			WELL NO.2			WELL NO.3			WELL NO.4		
DATE	TOP ELEV.	DIST. TO WATER	WATER ELEV.	TOP ELEV.	DIST. TO WATER	WATER ELEV.	TOP ELEV.	DIST. TO WATER	WATER ELEV.	TOP ELEV.	DIST. TO WATER	WATER ELEV.
10/28/86	235.47	31.9	203.57	221.65	18.4	203.25	219.85	16.1	203.75	222.17	16.9	205.27
04/09/87	235.47	26.5	208.97	221.65	14.7	206.95	219.85	13.7	206.15	222.17	13.2	208.97
09/03/87	235.47	32.7	202.77	221.65	21.6	200.05	219.85	22.3	197.55	222.17	25.0	197.17
12/03/87	235.47	34.5	200.97	221.65	24.1	197.55	219.85	-	NA	222.17	16.5	205.67
10/06/88	235.47	35.1	200.37	221.65	-	NA	219.85	-	NA	222.17	-	NA
05/11/89	235.47	25.4	210.07	221.65	11.7	209.95	219.85	11.9	207.95	222.17	12.4	209.77

- INDICATES DRY WELL
NA INDICATES NOT APPLICABLE



Fullen Farms, Inc.
Parcel 1, Pt. 2
Parcel 1, Pt. 1
Burlington
Road
P.O.B.
P.O.D.
TVA Tower
Parcel 2, Pt. 1
Main Plant Area
Landfill
#4
#3
#2
#1
Parcel I
NPDES
SAMPLING POINT
Access
Road
Electric Transmission Easement
Harvester Lane
Fence
Parcel 3
Memphis-Shelby County Airport
Memphis-Shelby County
Airport Authority
Whitney Avenue
Memphis & Shelby
N
● Monitoring Wells
ɪ Soil Sampling Points
International Harvester (IH)
Landfill Site
Memphis, Tennessee

Figure 1

REPORT OF ANALYSIS **Reference 16**

TENN. DEPT. OF HEALTH & ENVIRONMENT BILLING CODE:

SOURCE INTERNATIONAL HARVESTER

IDENTIFICATION WELL #4, DOWNGRADIENT

FIELD # ____ COLLECTED BY BWAN PRIMARY STATION # ____ DATE COLLECTED 04 DEC 87

TIME COLLECTED 1530 SAMPLE DEPTH (IN FEET) ____ JBL LAB NUMBER JSF-275 *

10-Temperature °C		2	340-C.O.D. mg/L (High Level)	
300-D.O. mg/L		3	335-C.O.D. mg/L (Low Level)	
310-5-day B.O.D. 20°C mg/L		4	70508-Acidity Total - Hot mg/L	
403-pH, Lab.		5	412-Alkalinity (Net) mg/L	
400-pH, Field		6	38260-MBAS mg/L	
81-App. Color Pt - Co units		7	95-Conductivity Micromho 25°C	
80-True Color Pt - Co units		8	1105-Aluminum as Al ug/L	116,240
70-Turbidity NTU		9	1007-Barium as Ba ug/L	2129
410-Total Alk. as $CaCO_3$ mg/L		10	1032-Chromium-Hex. as Cr. ug/L	
415-Phth. Alk. as $CaCO_3$ mg/L		11	1033-Chromium-Tri. as Cr. ug/L	
437-Acidity as $CaCO_3$ mg/L		12	1034-Chromium-total as Cr. ug/L	169
900-Total Hardness as CaCO3 mg/L		13	1037-Cobalt as Co ug/L	
910-Calcium as $CaCO_3$ mg/L		14	1147-Selenium-total as Se ug/L	~~46~~ <1
927-Magnesium as Mg mg/L		15	1145-Selenium (Diss.) as Se ug/L	
929-Sodium as Na mg/L		16	1077-Silver as Ag ug/L	<10
937-Potassium as K mg/L		17	32730-Phenols ug/L	
500-Total Residue mg/L		18	1022-Boron-Total as B ug/L	
530-Sus. Residue mg/L		19	615-Nitrite Nitrogen as N mg/L	
70300-Diss. Residue mg/L		20	620-Nitrate Nitrogen as N mg/L	
31501-Coliform No./100 ml.		21	405-Free CO_2 mg/L	
31616-Fecal Coliform No./100 ml.		22	505-Total Vol. Residue mg/L	
31679-Fecal Strep. No. 100 ml.		23	535-Vol. Sus. Residue mg/L	
635-Total Kil.Nitrogen as N mg/L		24	545-Settleable Residue ml/L	
630-NO_3 & NO_2 as N mg/L		25	666-Diss. Phosphate as P mg/L	
1097-Antimony as Sb ug/L		26	745-Sulfide, total as S mg/L	
1045-Iron as Fe ug/L		27	746-Sulfide, Dissolved as S mg/L	
1055-Manganese as Mn ug/L		28	369-Cl_2 Demand, 30 min. mg/L	
940-Chloride as Cl mg/L		29	50064-Cl_2, Free Res. mg/l	
950-Fluoride as F mg/L		30	50060-Cl_2, Combined Res. mg/L	
665-Total Phosphate as P mg/L		1	690-Total Carbon mg/L	
945-Sulfate as SO_4 mg/L		2	550-Oil and Grease mg/L	
680-Total Organic Carbon mg/L		3	720-Cyanide as CN mg/L	
1067-Nickel as Ni ug/L	264	4	32240-Tannin and Lignin mg/L	
71900-Mercury-Total as Hg ug/L	0.5	5	610-Ammonia Nitrogen as N mg/L	
1051-Lead as Pb ug/L	141	6	605-Organic Nitrogen as N mg/L	
1042-Copper as Cu ug/L	207	7	58-Flow Rate CFM	
1002-Arsenic as As ug/L	41.0	8	61-Flow Rate CFS, Instantaneous	
1027-Cadmium as Cd ug/L	13	9	60-Flow Rate CFS, Mean Daily	
1092-Zinc as Zn ug/L	656	10		
955-Silica as SiO_2 mg/L		11		

REMARKS: * THIS SAMPLE IS UNFILTERED

DIVISION SFF PROGRAM CODE ____ PRIORITY C

W ____ PH-0549, WQC-6/79

WW ____ Reported 04 Jan 88 (VWS)

CL ____

R

LEGAL

1-4-88

REPORT OF ANALYSIS

TENN. DEPT. OF HEALTH & ENVIRONMENT BILLING CODE:

SOURCE INTERNATIONAL HARVESTER

IDENTIFICATION WELL #4, DOWN GRADIENT

FIELD # ____ COLLECTED BY BURN ~~HIGHTOWER~~ PRIMARY STATION # ____ DATE COLLECTED 04 DEC 87

TIME COLLECTED 1530 SAMPLE DEPTH (IN FEET) ________ DEL LAB NUMBER JSF-275F*

10-Temperature °C			2	340-C.O.D. mg/L (High Level)	
00-D.O. mg/L			3	335-C.O.D. mg/L (Low Level)	
10-5-day B.O.D. 20°C mg/L			4	70508-Acidity Total - Hot mg/L	
03-pH, Lab.			5	412-Alkalinity (Net) mg/L	
00-pH, Field			6	38260-MBAS mg/L	
81-App. Color Pt - Co units			7	95-Conductivity Micromho 25°C	
80-True Color Pt - Co units			8	1105-Aluminum as Al ug/L	✓ 24,310
70-Turbidity NTU			9	1007-Barium as Ba ug/L	✓ 1267
10-Total Alk. as $CaCO_3$ mg/L			10	1032-Chromium-Hex. as Cr. ug/L	
15-Phth. Alk. as $CaCO_3$ mg/L			11	1033-Chromium-Tri. as Cr. ug/L	
37-Acidity as $CaCO_3$ mg/L			12	1034-Chromium-total as Cr. ug/L	✓ 39
00-Total Hardness as $CaCO_3$ mg/L			13	1037-Cobalt as Co ug/L	
10-Calcium as $CaCO_3$ mg/L			14	1147-Selenium-total as Se ug/L	✓ 1.6
27-Magnesium as Mg mg/L			15	1145-Selenium (Diss.) as Se ug/L	
29-Sodium as Na mg/L			16	1077-Silver as Ag ug/L	✓ <10
37-Potassium as K mg/L			17	32730-Phenols ug/L	
00-Total Residue mg/L			18	1022-Boron-Total as B ug/L	
30-Sus. Residue mg/L			19	615-Nitrite Nitrogen as N mg/L	
0300-Diss. Residue mg/L			20	620-Nitrate Nitrogen as N mg/L	
1501-Coliform No./100 ml.			21	405-Free CO_2 mg/L	
1616-Fecal Coliform No./100 ml.			22	505-Total Vol. Residue mg/L	
1679-Fecal Strep. No. 100 ml.			23	535-Vol. Sus. Residue mg/L	
35-Total Kil.Nitrogen as N mg/L			24	545-Settleable Residue ml/L	
30-NO_3 & NO_2 as N mg/L			25	666-Diss. Phosphate as P mg/L	
097-Antimony as Sb ug/L			26	745-Sulfide, total as S mg/L	
045-Iron as Fe ug/L			27	746-Sulfide, Dissolved as S mg/L	
055-Manganese as Mn ug/L			28	369-Cl_2 Demand, 30 min. mg/L	
40-Chloride as Cl mg/L			29	50064-Cl_2, Free Res. mg/l	
950-Fluoride as F mg/L			30	50060-Cl_2, Combined Res. mg/L	
65-Total Phosphate as P mg/L			1	690-Total Carbon mg/L	
45-Sulfate as SO_4 mg/L			2	550-Oil and Grease mg/L	
80-Total Organic Carbon mg/L			3	720-Cyanide as CN mg/L	
067-Nickel as Ni ug/L	✓	127	4	32240-Tannin and Lignin mg/L	
71900-Mercury-Total as Hg ug/L	✓	0.2	5	610-Ammonia Nitrogen as N mg/L	
051-Lead as Pb ug/L	✓	78	6	605-Organic Nitrogen as N mg/L	
042-Copper as Cu ug/L	✓	121	7	58-Flow Rate CFM	
002-Arsenic as As ug/L	✓	5.13	8	61-Flow Rate CFS, Instantaneous	
027-Cadmium as Cd ug/L	✓	13	9	60-Flow Rate CFS, Mean Daily	
092-Zinc as Zn ug/L	✓	346	10		
955-Silica as SiO_2 mg/L			11		

REMARKS: * THIS SAMPLE HAS BEEN FILTERED THRU WHAT #31 PREDIGEST

DIVISION ________ PROGRAM CODE ________ PRIORITY ________

W ________ PH-0549, WQC-6/79

WW ________ reported organics MVS

CL ________

P ________ 1-11-88

LEGAL

REPORT OF ANALYSIS

TENN. DEPT. OF HEALTH & ENVIRONMENT

J

BILLING CODE: SSF

SOURCE INTERNATIONAL HARVESTER

IDENTIFICATION WELL #1 BACKGROUND

FIELD # 1 COLLECTED BY BNAN PRIMARY STATION # ____ DATE COLLECTED 04 DEC 87

TIME COLLECTED 1042 SAMPLE DEPTH (IN FEET) ____ CBL LAB NUMBER SSF-274

10-Temperature °C		2	340-C.O.D. mg/L (High Level)		1
00-D.O. mg/L		3	335-C.O.D. mg/L (Low Level)		1
10-5-day B.O.D. 20°C mg/L		4	70508-Acidity Total - Hot mg/L		1
03-pH, Lab.		5	412-Alkalinity (Net) mg/L		1
00-pH, Field		6	38260-MBAS mg/L		1
81-App. Color Pt - Co units		7	95-Conductivity Micromho 25°C		1
80-True Color Pt - Co units		8	1105-Aluminum as Al ug/L	9502	1
70-Turbidity NTU		9	1007-Barium as Ba ug/L	515 115	1
10-Total Alk. as $CaCO_3$ mg/L		10	1032-Chromium-Hex. as Cr. ug/L		2
15-Phth. Alk. as $CaCO_3$ mg/L		11	1033-Chromium-Tri. as Cr. ug/L		2
37-Acidity as $CaCO_3$ mg/L		12	1034-Chromium-total as Cr. ug/L	800	2
00-Total Hardness as CaCO3 mg/L		13	1037-Cobalt as Co ug/L		2
10-Calcium as $CaCO_3$ mg/L		14	1147-Selenium-total as Se ug/L	<1	2
27-Magnesium as Mg mg/L		15	1145-Selenium (Diss.) as Se ug/L		2
29-Sodium as Na mg/L		16	1077-Silver as Ag ug/L	1	2
37-Potassium as K mg/L		17	32730-Phenols ug/L		2
00-Total Residue mg/L		18	1022-Boron-Total as B ug/L		2
30-Sus. Residue mg/L		19	615-Nitrite Nitrogen as N mg/L		2
0300-Diss. Residue mg/L		20	620-Nitrate Nitrogen as N mg/L		3
31501-Coliform No./100 ml.		21	405-Free CO_2 mg/L		
31616-Fecal Coliform No./100 ml.		22	505-Total Vol. Residue mg/L		
31679-Fecal Strep. No. 100 ml.		23	535-Vol. Sus. Residue mg/L		
25-Total Kjl.Nitrogen as N mg/L		24	545-Settleable Residue ml/L		
30-NO_3 & NO_2 as N mg/L		25	666-Diss. Phosphate as P mg/L		
1097-Antimony as Sb ug/L		26	745-Sulfide, total as S mg/L		
1045-Iron as Fe ug/L		27	746-Sulfide, Dissolved as S mg/L		
1055-Manganese as Mn ug/L		28	369-Cl_2 Demand, 30 min. mg/L		
940-Chloride as Cl mg/L		29	50064-Cl_2, Free Res. mg/l		
950-Fluoride as F mg/L		30	50060-Cl_2, Combined Res. mg/L		1
665-Total Phosphate as P mg/L		1	690-Total Carbon mg/L		1
945-Sulfate as SO_4 mg/L		2	550-Oil and Grease mg/L		1
680-Total Organic Carbon mg/L		3	720-Cyanide as CN mg/L		1
1067-Nickel as Ni ug/L	21	4	32240-Tannin and Lignin mg/L		1
71900-Mercury-Total as Hg ug/L	<0.2	5	610-Ammonia Nitrogen as N mg/L		1
1051-Lead as Pb ug/L	31	6	605-Organic Nitrogen as N mg/L		1
1042-Copper as Cu ug/L	9	7	58-Flow Rate CFM		1
1002-Arsenic as As ug/L	3.06	8	61-Flow Rate CFS, Instantaneous		1
1027-Cadmium as Cd ug/L	1	9	60-Flow Rate CFS, Mean Daily		1
1092-Zinc as Zn ug/L	20	10			
955-Silica as SiO_2 mg/L		11			

REMARKS:

DIVISION SSF PROGRAM CODE ____ PRIORITY C

W ____

WW ____

CL ____

R

PH-0549, WQC-6/79

Checked & reported 04 JAN 88 WB

LEGAL

1-4-88

10a

ENVIRONMENTAL TESTING & CONSULTING INC.
2924 WALNUT GROVE RD. • MEMPHIS, TENN. 38111 • PHONE (901) 327-2750

May 23, 1988

RECEIVED JUN - 2 1988

Ms. Connie Hess, President
Hess Environmental Services, Inc.
6890 Hillshire Drive, Suite 13
Memphis, Tenn. 38134

REF: ANALYTICAL TESTING - SIH SAMPLES - SEDIMENT & COMPOSITE SOIL
SAMPLE(S) DATE: 5/5/88

Dear Ms. Hess:

The above referenced samples have been analyzed per your instructions. The tests were performed in our laboratory (#00210) in accordance with SW-846, Method 8080 & 3550. The results are shown on the attached Organic Analysis Data Sheet.

If you have any questions please feel free to contact me.

Very truly yours,

Michael J. Cimbalo
President

MJC/mg

Attachment

ENVIRONMENTAL TESTING & CONSULTING INC.
2924 WALNUT GROVE RD. • MEMPHIS, TENN. 38111 • PHONE (901) 327-2750

June 1, 1988

RECEIVED JUN - 2 1988

Ms. Connie Hess, President
Hess Environmental Services, Inc.
6890 Hillshire Drive, Suite 13
Memphis, Tenn. 38134

REF: ANALYTICAL TESTING
SAMPLE(S) DATE: 5/5/88
SAMPLE I.D.: SIH SAMPLES - SURFACE & GROUND WATER, SEDIMENT & COMPOSITE SOILS

Dear Ms. Hess:

The above referenced samples have been analyzed per your instructions. The tests were performed in our laboratory (#00210) in accordance with Standard Methods, 16th Edition, and the results are shown below.

	SIH Samples - Results (mg/l)					Standard Methods		
	Surface	Ground Water						
Tests	Water #1	#1	#2	#3	#4	Page #	By	Date
Chromium	<0.02	0.63	0.04	0.06	0.11	157	JF	5/6
Lead	<0.05	<0.05	<0.05	<0.05	<0.05	157	JF	5/6

		Composite Soils		Standard Methods		
	Sediment #1	South #1	North #2			
Tests	(as rec. ppm)	(Dry Weight ppm)		Page #	By	Date
Chromium	10.3	16.2	16.4	157	JF	5/6
Lead	12.2	25.3	24.2	157	JF	5/6
% Moisture	-	4.74	5.50			

If you have any questions please feel free to contact me.

Very truly yours,

Michael J. Cimbalo
President

MJC/mg

ENVIRONMENTAL TESTING AND CONSULTING, INC.

ORGANIC ANALYSIS DATA SHEET
PCBs

SAMPLE NAME : _HESS ENVIRONMENTAL_

SAMPLE ID(S) : _SEE RESULTS____
SAMPLE DATE : _05/05/88_______
DATE ARRIVED : _05/06/88_______
MATRIX : _SEDIMENT/SOIL__

PROJECT # : _SIH_____
INSTRUMENT ID : _V3700___
ANALYST : _LB______

FILE NAME : _0506-002.DOC

DATE EXTRACTED/PREPARED : _05/18/88_
DATE ANALYZED : _05/19/88_

METHOD(SW-846) : _8080____
3550

COMPOUND	SAMPLE RESULTS UNITS: (mg/kg)	METHOD DETECTION LIMIT: (mg/kg)
	SEDIMENT #1	
TOTAL PCB	: ____0.04j____	______0.05______
	COMPOSITE SOIL #1	
TOTAL PCB	: ____0.04j____	______0.05______
	COMPOSITE SOIL #2	
TOTAL PCB	: _____BDL_____	______0.05______

RECEIVED JUN - 2 1988

Vi = Volume of extract injected (ul) : _3.0___________
Ws = Weight of sample extracted (g) : _30____________
Vt = Volume of final extract (ml) : _10____________

BDL - BELOW DETECTION LIMIT
j - ESTIMATED VALUE

Reference 17

RECEIVED

JUN 22 198?

REPORT OF GROUND WATER MONITORING,
WELL DEVELOPMENT AND POST
CLOSURE MONITORING AT THE
INTERNATIONAL HARVESTER LANDFILL SITE
MEMPHIS, TENNESSEE
-SECOND QUARTER, SECOND YEAR-

PREPARED BY:
HESS ENVIRONMENTAL SERVICES, INC.
MEMPHIS, TENNESSEE

JUNE 17, 1988

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SUMMARY

Second quarter, second year ground water, surface water, sediment and soil samples were collected and analyzed in compliance with post closure monitoring requirements set forth in the International Harvester Closure Plan, enforced by the State of Tennessee.

All water samples were analyzed for chromium and lead content. All sediment and soil samples were analyzed for chromium, lead and Polychlorinated Biphenyls (PCBs) content.

Ground water samples were collected from upgradient well no. 1 and downgradient wells no. 2, 3, and 4.

Where are the upgradient wells (horizontally and vertically) relative to plume? relative to other contaminant sources?

Second quarter, second year data is somewhat different from previous data in that metals levels increased in downgradient ground water and decreased in the sediment and north landfill composite.

All levels of chromium in downgradient ground water were low and were well below that found in upgradient ground water and therefore should not be of concern. No lead was detected in any of the ground water sampled. Based on this data, the landfill can not be said to have impacted the ground water in its vicinity. (? at this time)

Maybe not - but this is not sufficient rationale for "no concern"

No metals were detected in the surface water composite, this is consistent with data from previous quarters.

Sediment and soil from the composite collected north of the NPDES discharge point contained reduced levels of metals as compared with first year data. These decreases probably reflect a combination of the ranges of chromium and lead present at the site and normal variations in laboratory data.

or further leaching

No other remarkable data was noted.

A summary of all second quarter, second year data is displayed in Table IV of this report.

I. INTRODUCTION

Prior to initiating second quarter, second year post closure monitoring, Hess Environmental Services, Inc. (HES) developed the four (4) ground water monitoring wells surrounding the International Harvester Landfill. These wells were first developed in November of 1986. Since then, ground water recharge rates have become slower in these wells necessitating this redevelopment effort.

To comply with post closure monitoring requirements set forth in the International Harvester (IH) Closure Plan enforced by the State of Tennessee, Department of Health and Environment, Division of Superfund (the State), HES collected ground water samples from four (4) ground water monitoring wells, water and sediment samples from the National Pollutant Discharge Elimination System (NPDES) discharge point and soil samples from two (2) areas at the base of the landfill.

All samples were analyzed for chromium and lead content. The soil samples collected below the landfill and the sediment sample collected from the NPDES discharge point were also analyzed for PCB content.

This report addresses well development, sampling, testing and chain-of-custody protocols followed to fulfill second quarter, second year, post closure monitoring requirements.

II. WELL DEVELOPMENT

On April 26, 1988, HES provided personnel to develop the four (4) ground water monitoring wells at the International Harvester Landfill Site, Memphis, Tennessee.

HES team members participating in this effort were:

Marolyn Howe - Chemical Engineer
Jeff Bennett - Environmental Scientist

The well development process is used to restore the natural hydraulic conductivity of the subsurface formation and remove foreign materials which may have been introduced during well construction. This process should speed up recent sluggish recharge rates.

The well development protocol used by HES employed reversals of flow surges to avoid particle bridging, a phenomenon which frequently occurs when flow is continuously in one direction. The surges also served to flush the sand pack around the well screens removing drilling and/or soil fines that may have been present in the monitoring wells.

At each monitoring well developed, the depth to ground water was measured, using the YSI Model 3000 T-L-C meter, to the nearest hundredth (0.01) of a foot. The volume of ground water in each well was calculated as follows:

(T. Depth of Well*) - (Depth to water*) = ht. of water col.*
(Ht. water col.*) x (gal. water/ft. pipe) = vol. of std. water**

*Feet.
**Gallons.

The two (2) inch ID well casings have 0.16 gallons of water per linear foot of well casing.

During well development, two (2) volumes of standing water were removed from well no. 1 using a Teflon bailer, wells no. 2, 3, and 4 (slow recharge wells) were bailed to dryness. As soon as bailing was complete and the wells recharged, the depth to water was measured using the T-L-C meter. A recovery rate was established by measuring the depth to water at regular time intervals until a consistent recovery rate was attained.

Once the recovery rate for each well was determined, the air compressor holding tank was filled to approximately 100 psi. Air pressure was applied through the center of the casing (with a hand cover top seal) in short vigorous blasts, using a bent air hose to control air burst. Surging blasts of air were applied until the air compressor had too little air remaining to continue. This constituted the "blow down" of a well.

Immediately after blow down was completed, the water level in the well was measured and recorded. Two (2) volumes of standing water were then removed (bailed), the depth to water measured and water level recovery in the well recorded with respect to time, as previously outlined.

The bailing, timed recovery and air pressure blow down steps were repeated until it was determined that either an improved recovery rate had been established and the recovery rate was not further improved by additional bailing and blow down or that the initial recovery rate was the maximum rate achievable because it was not improved by the bailing and blow down process.

III. SAMPLE COLLECTION

On May 5, 1988, HES provided personnel to collect: ground water samples from three (3) downgradient wells no. 2, 3, and 4, and one (1) upgradient well no. 1; one (1) sediment composite and one (1) surface water composite from the NPDES discharge point ditch; and two (2) soil composites, the first from below the landfill on the south side, and the second from below the landfill on the north side. All sampling locations at the International Harvester Landfill Site are shown in Figure 1.

Present on site during sample collection were:

Marolyn Howe	-	Chemical Engineer with HES
Jeff Bennett	-	Environmental Scientist with HES
Bobby G. King	-	Environmental Specialist, State of Tennessee

Weather conditions were clear, sunny and 16°C (61°F).

A - Ground Water Monitoring Wells

Each of the four (4) two (2) inch ID ground water monitoring wells had a protective, metal, outer well casing with a pad-locked lid. HES found all lids locked. Before sampling, the well depth and the depth to the surface of the ground water was measured in each well and the volume of the standing water calculated. A record of these measurements is shown in Table I.

A Well Wizard stainless steel portable positive gas displacement bladder pump, Model ST110P, with a Teflon bladder, Teflon tubing and a stainless steel intake screen was used to evacuate one (1) volume of standing water and three (3) volumes of recharge water from upgradient well.

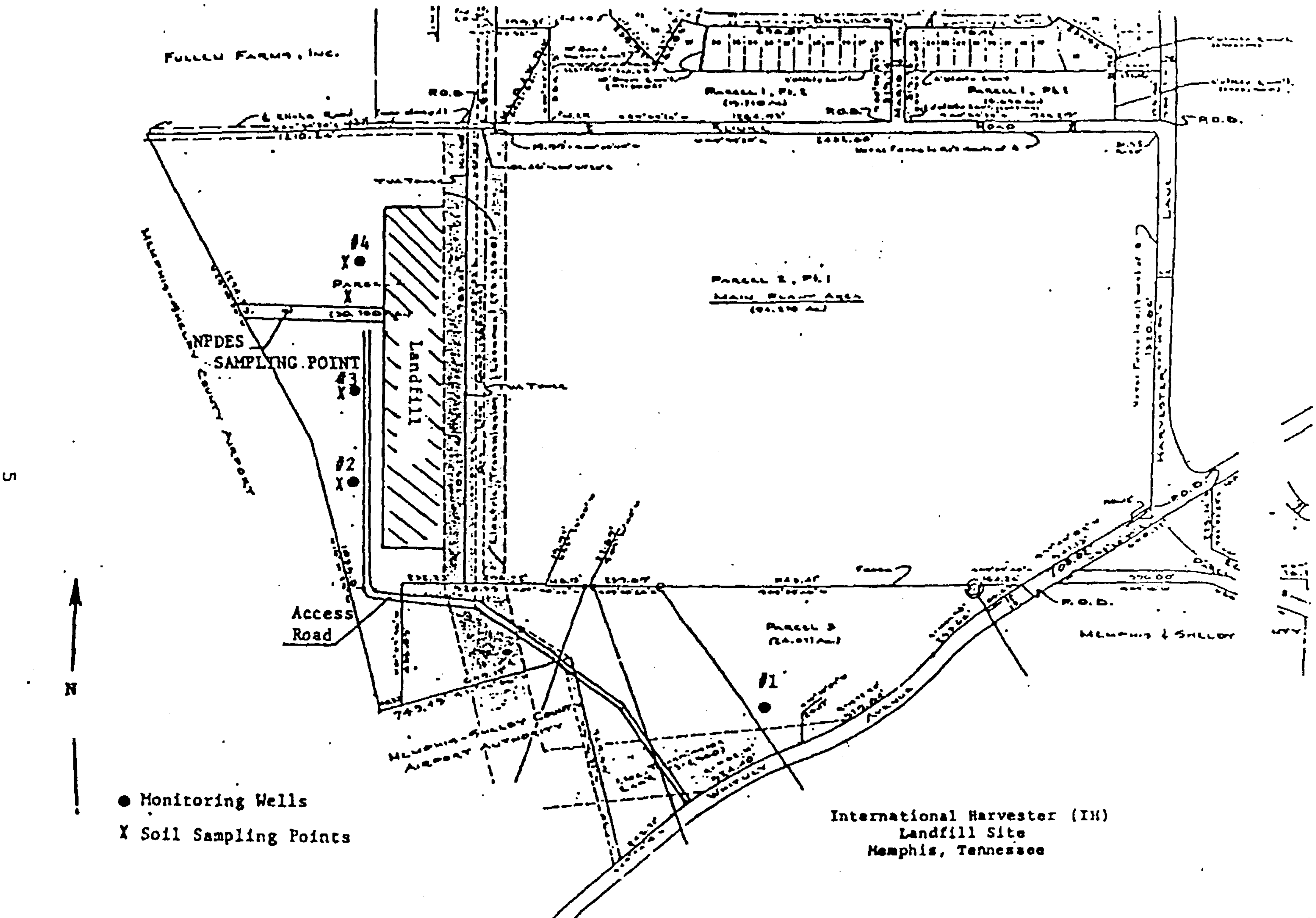
R.O.D.
Parcel 2, Pt.1
Main Plant Area
Parcel 3
Landfill
#4
#3
#2
#1
NPDES
SAMPLING POINT
Access
Road
N
● Monitoring Wells
X Soil Sampling Points
International Harvester (IH)
Landfill Site
Memphis, Tennessee

Figure 1

TABLE I

MONITORING WELL
MEASUREMENTS

	1	2	3	4
Total Depth of Well (Ft.)	41.8	24.7	24.7	24.8
Depth from MP* to Top of Water Column (Ft.)	28.0	16.4	16.3	14.1
Height of Water Column (Ft.)	13.8	8.3	8.4	10.7

*MP = Measuring Point, an area (point) at the top of each PVC well casing used as a reference point for measurements.

Breathing grade air was used to inflate the pump bladder facilitating sample collection.

Ground water was filtered using a 0.45 micron filter attached to the discharge tube of the ST1100P pump and pumped into precleaned glass sample containers with Teflon lined lids.

A Teflon bailer was used to evacuate one (1) volume of standing water and three (3) volumes of recharge water from the downgradient wells no. 2, 3, and 4. The bailer was used instead of the pump because these wells had a slower recharge rate. Ground water from wells no. 2, 3, and 4 were filtered through a 0.45 micron filter at the laboratory.

All ground water samples were stored on ice (<$4^{o}C$) immediately after collection (in the field). Ground water from well no. 1 to be analyzed for metals was pH adjusted with nitric acid to a pH of <2. Ground water from wells no. 2, 3 and 4 was filtered then preserved, with nitric acid to a pH of less <2, at the laboratory. why?

why filter? or at least why filter down-gradient & not upgradient

All sample container cleaning, preservation and analytical procedures were performed in accordance with "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March, 1979, as referenced in the "Rules Governing Hazardous Waste Management in Tennessee." See Table II for the specific analytical method references for each parameter.

Established chain-of-custody sample handling protocols were followed. A "Field Log Book" was kept, as required in the chain-of-custody protocol. Pertinent data concerning the site in general, weather conditions and data collected during the sampling event were recorded. This log is updated during each quarter's sampling event.

TABLE II

ANALYTICAL METHODS

PARAMETER	WATER SAMPLES METHOD REFERENCE	SOIL/SEDIMENT SAMPLES METHOD REFERENCES
Chromium	302D*, 303A*	302D*, 303A*
Lead	302D*, 303A*	302D*, 303A
PCB	-	3550, 8080**

*Standard Methods for the Examination of Water and Wastewater, 16th Edition, American Public Health Association, Inc., New York, New York, 1985.

**Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, (SW-846), Third Edition, U. S. Environmental Protection Agency, 1986.

Environmental Testing and Consulting, Inc. (ETC), received samples from all four (4) wells. ETC is a laboratory certified by the State of Tennessee (Certificate No. 00210). Samples were delivered to ETC via courier on May 6, 1988.

All samples arrived at the laboratory with seals intact.

certified for what?
1. drinking water
2. haz waste

B - NPDES Discharge Point

Samples were collected at the NPDES discharge sampling point, below the discharge of storm water, located in the northwest area of Parcel 4 (see Figure 1). A water and then a sediment composite were collected from this discharge point.

HES personnel collected grab samples of water from two (2) locations along the south bank in the vicinity of the NPDES discharge point. Water was scooped from each location via a clean glass sampling jar then added to a second jar to form the composite. Equal portions of water from each grab sample were poured into the composite accumulation jar; when all grabs were deposited into the accumulation jar the sample was pH adjusted to pH <2 with nitric acid, then covered with a Teflon lined lid.

why composite two sites along same bank Are there two separate points for two separate discharges

Four (4) sediment grab samples were collected in the same general area as the water grabs. Sediment grabs were scooped from the rocky stream bed by raking a sampler, comprised of a small stainless steel beaker attached to a stainless steel pole, across each area then pouring each scoop raked into a glass sampling jar. The sediment accumulated in the jar was then stirred with a stainless steel spatula to form a uniform composite. The jar was then covered with a Teflon lined lid.

Both composite samples were sealed by placing a chain-of-custody seal across each jar lid and down the sides of the jar. The samples were then stored on ice (<4^{o}C) along with the ground water samples. Both samples were delivered along with the monitoring well samples, to ETC, via courier, on May 6, 1988.

C - Soil Composites

Two (2) soil composite samples were collected at the landfill site, one (1) north and the second south of the NPDES (and storm water) discharge point, below the west face of the landfill.

All areas sampled are shown in Figure I. A description of the soil areas sampled is provided in Table III.

The north and south soil composites were each formed by mixing grabs collected with a stainless steel core sampler. Two (2) 6" x 1" solid cores were collected from each of the two (2) areas north of the NPDES discharge point and deposited into a Pyrex glass tray. All soil was then mixed with a stainless steel spoon to form as uniform a composite as possible. A sample jar was filled with soil from this composite, covered with a Teflon lined lid then sealed with a chain-of-custody seal by HES personnel. The south soil composite was formed in the same manner from cores collected in two (2) areas south of the NPDES discharge point.

Both soil composites were stored on ice (<$4^{\circ}C$) along with the water and sediment samples and delivered to ETC, via courier on May 6, 1988.

TABLE III

LOCATION OF SOIL COMPOSITES COLLECTED

COMPOSITES	LOCATIONS SAMPLED
South Composite:	
Grab S1	20 feet due west of well #2
Grab S2	20 feet due west of well #3
North Composite:	
Grab N1	3 feet due west of well #4
Grab N2	60 feet due south of well #4

IV. DISCUSSION OF DATA

As stipulated in the International Harvester Closure Plan, all water, soil and sediment samples were analyzed for chromium and lead content. The soil and sediment samples were also analyzed for PCB content.

A summary of all second quarter, second year laboratory data is presented in Table IV, the actual laboratory report is included in the Appendix of this report. A discussion of current data follows:

GROUND WATER

* Chromium levels in downgradient ground water from wells 2-4 are slightly higher than the levels measured in ground water from the same wells during the first year.

* The chromium level in upgradient ground water is above downgradient levels; it is comparable with historical data.

would difference in filtering account for this? Ie field filtering now accepted for sampling procedure

* Lead was not found in any of the ground water samples collected at the site; this is also comparable with historical data.

SURFACE WATER

* Chromium and lead were not detected in the surface water composite collected this quarter; this is consistent with past data.

why composite from 2 points if concern is only from "NPDES (and storm water)" outfall

~~Before~~ how do these numbers compare w/ MCL

Is there a lab. detection limit = MCL

TABLE IV

SUMMARY OF DATA

GROUND WATER MONITORING WELLS	UNITS	CHROMIUM	LEAD	PCB
#1	mg/l	0.63	<0.05	-
#2	mg/l	0.04	<0.05	-
#3	mg/l	0.06	<0.05	-
#4	mg/l	0.11	<0.05	-
NPDES DISCHARGE·POINTS				
Surface Water Comp.	mg/l	<0.02	<0.05	-
Sediment Comp.	mg/Kg	10.3	12.2	<0.25
SOILS				
North Landfill Comp.*	mg/Kg	16.4	24.2	<0.25
South Landfill Comp.*	mg/Kg	16.2	25.3	<0.25
BACKGROUND COMP. 4/9/87	mg/Kg	6.9	44.7	<0.25
PUBLISHED AVERAGE BACKGROUND LEVELS	mg/Kg	100 (1)	302 (2)**	<1 (3)

REFERENCES:

(1) Allaway, W.H., 1968. Agronomic controls over the environmental cycling of trace elements. Adv. Agron. 20: 235-274.

(2) Final Report of Soil Sampling and Analysis for the North Hollywood Dump Health Effects Study, Hess Environmental Services, Inc., May 30, 1986.

(3) Richardson, B.J. and Waid, J.S. (1982). Polychlorinated Biphenyls (PCB): An Australian viewpoint on a global problem. Search 13, 17.

*Dry Weight Basis.

**Range 40.7 to 2002 mg/Kg.

SEDIMENT

* Current chromium and lead levels are lower than levels previously observed in site sediment. No PCBs were found in the sediment; historical data ranges from 5.1 mg/kg (ppm) to none detected (<0.25 mg/kg).

why?

SOIL

* Current soil chromium, lead and PCB data from the landfill composite collected south of the NPDES discharge point is generally comparable with data from previous quarters.

* Current soil chromium, lead and PCB data from the landfill collected north of the NPDES discharge point composite is generally lower than data from previous quarters.

V. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be drawn from data obtained during the second quarter, second year, post closure, monitoring at the International Harvester landfill site:

* Because metals found in downgradient ground water are at or below levels found in upgradient ground water and no metals have been found in surface water, the landfill can not be said to have impacted ground water or surface water in its vicinity.

I don't necessarily agree w/ this as the conclusion is not strictly supported by the premises or the data herein.

* Second quarter, second year data is somewhat different from previous data.

* Downgradient ground water contained low levels of chromium. No chromium had been detected in these wells during the first year of monitoring. This should not be of concern however, because downgradient levels are very low and are well below the chromium level found in upgradient ground water.

define <u>low</u>

this is not a valid reason for no concern potential?

* Metals in the sediment composite and soil from the north landfill composite were below first year levels. These data variations probably reflect a combination of the ranges present in soil and sediments at the site and normal variations in laboratory data.

what about leaching? Why repeat all this? Saying it twice lends no greater validity

* All other current data is comparable with first year data.

No action beyond reporting the data contained in this report to the Tennessee Department of Health and Environment, Division of Superfund, should be required until the fourth quarter, 1988, when monitoring will again be required.

Oh yes there is! (1) the questions
problem need answers which can
be evaluated by expertise
employed by TDHE.
(2) I want to see the site.
(3) I want to accompany
the next monitoring run.

APPENDIX
LABORATORY REPORT

#79525

Reference 18

RECEIVED

JUL 14 1989

REPORT OF POST CLOSURE MONITORING AT THE INTERNATIONAL HARVESTER LANDFILL SITE MEMPHIS, TENNESSEE - SECOND QUARTER, THIRD YEAR -

PREPARED FOR:
DR. SHELMAN KELMAN
PIÇKERING FIRM
MEMPHIS, TENNESSEE

PREPARED BY:
HESS ENVIRONMENTAL SERVICES, INC.
MEMPHIS, TENNESSEE

JUNE 26, 1989

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Appendix

EXECUTIVE SUMMARY

Second quarter, third year ground water, surface water, sediment and soil samples were collected and analyzed in compliance with post closure monitoring requirements delineated in International Harvester's Landfill Closure Plan, as enforced by the State of Tennessee.

Ground water samples were collected from the four (4) monitoring wells on site, which include one (1) upgradient well (No. 1) and three (3) downgradient wells (Nos. 2, 3 and 4). All ground water samples were analyzed for chromium and lead content.

Chromium was detected in the ground water sample collected from upgradient Well No. 1, southwest of the landfill. No metals were found in ground water samples collected from the downgradient wells. It would probably be advisable to survey the Measuring Point (MP) on the casing of each well with respect to Mean Sea Level (MSL) to varify that well No. 1 is currently an upgradient well.

Surface water and sediment composite samples were collected from the National Pollutant Discharge Elimination System (NPDES) discharge point. No metals were detected in the surface water composite, which is consistent with data from previous sampling events; sediment data is addressed below.

Soil composite samples were collected from two (2) areas at the base of the landfill. All sediment and soil samples were analyzed for chromium, lead and Polychlorinated Biphenyls (PCBs) content.

Metals and PCBs were found in all soil and sediment composites, but the levels of these constituents were comparable with those previously found at this site, and were below published background levels for soils.

A summary of all analytical data is presented in Table IV.

A copy of this report should be submitted to the State. No further action is required until fourth quarter, when monitoring will again be required.

I. INTRODUCTION

The State of Tennessee, Department of Health and Environment, Division of Superfund (the State), enforces the International Harvester (IH) Landfill Closure Plan. To comply with post closure monitoring requirements delineated in that plan (and modified as noted below), Hess Environmental Services, Inc. (HES) collected ground water samples from Monitoring Wells Nos. 1 -4, water and sediment samples from the NPDES discharge point and soil samples from two (2) areas at the base of the landfill.

The Closure Plan, referenced above, has been modified, monitoring is now required on a semi-annual basis, a reduction from the quarterly monitoring originally required.

All samples were analyzed for chromium and lead content. The soil samples collected below the landfill and the sediment samples collected from the NPDES discharge point were also analyzed for PCB content.

This report addresses sampling, testing and chain-of-custody protocols followed to fulfill the first semi-annual, third year, post closure monitoring requirements.

II. SAMPLE COLLECTION

On May 11, 1989, Hess provided a team to collect:

* Ground water samples from three (3) downgradient wells (Nos. 2, 3 and 4) and one (1) upgradient well (No. 1),

* One (1) surface water composite and one (1) sediment composite from the NPDES discharge point ditch, and

* Two (2) soil composites: the first from below the landfill on the north side of the NPDES discharge point, and the second from below the landfill on the south side of the NPDES discharge point.

All sampling locations at the IH Landfill Site, Parcel 4, are shown in Figure I.

Present at the IH site during sample collection were: Mr. Jeff Bennett, a HES Environmental Scientist, Mr. John Stedman Jr., a HES Environmental Engineer, and Mr. Jordan English, a representative from the State of Tennessee, Division of Superfund.

During this sampling event the weather was mild and sunny; the temperature was 65 degrees F.

A. Ground Water Monitoring Wells

Each of the four (4), two (2) inch ID ground water monitoring wells had a protective, metal, outer well casing with a pad-locked lid. HES personnel found all the lids locked. Before sampling, the well depth and the depth to the surface of the ground water was measured in each well and the volume of standing water calculated. These measurements are shown in Table 1. A Teflon bailer was used to evacuate one (1) volume of standing water and three (3) volumes of recharge water from well Nos. 1 - 4. This is in accordance with the protocol described in the Environmental Protection Agency's (EPA), Resource Conservation and Recovery Act (RCRA), Ground Water Monitoring Technical Enforcement Guidance Document.

The ground water samples were stored in jars, on ice (<4^{o}C) for preservation, immediately after collection. Ground water samples collected for chromium and lead analyses were filtered at the laboratory. After filtering, the samples were preserved with nitric acid to a pH of less than (<) 2.

All sample container cleaning, sample preservation and analyses were performed in accordance with "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March, 1979, as referenced in the "Rules Governing Hazardous Waste Management in Tennessee". See Table II for the specific analytical method employed for each parameter.

Established chain-of-custody sample handling protocols were followed. A "Field Log Book" was kept, as required in the chain-of-custody protocol, to record general site and weather data, as well as data collected during each sampling event. This log will be updated during each future sampling event.

All of the samples were shipped, via reliable courier on May 12, 1989, to Environmental Testing and Consulting, Inc. (ETC), a laboratory certified by the State (Certification 00210). ETC received all of the sample jars with their seals intact.

TABLE I
MONITORING WELL MEASUREMENTS

PARAMETER	WELL NUMBER 1	2	3	4
Total Depth of Well	41.80	24.75	24.75	25.55
Depth from MP to top of water column	25.40	11.70	11.93	12.40
Height of water column	16.40	13.05	12.82	13.15

Notes: MP = Measuring Point, an area (point) at the top of each PVC well casing used as a reference point for measurements.

All measurements are in feet.

TABLE II
ANALYTICAL METHODS

PARAMETER	WATER SAMPLES METHOD REFERENCE	SOIL/ SEDIMENT SAMPLES METHOD REFERENCE
Chromium	302D*, 303A*	302D*, 303A*
Lead	302D*, 303A*	302D*, 303A*
PCBs	-	3540**, 8080**

*<u>Standard Methods for the Examination of Water and Wastewater,</u> 16th Edition, American Public Health Association, Inc., New York, New York, 1985.

**<u>Test Methods for Evaluating Solid Waste, Physical Chemistry Methods,</u> SW-846, Second Edition, Revised, 1985, U.S. Environmental Protection Agency.

B. NPDES Discharge Point

Samples were collected at the NPDES discharge sampling point, located at the foot of the landfill, an earthen ditch which channels storm water runoff. This ditch is located in the northwest area of Parcel 4 (see Figure I). Water and sediment composites were collected in the vicinity of this discharge point.

HES personnel collected grab samples of water from two (2) locations along the south bank of the ditch, near the NPDES discharge point. Water was scooped from each location via a clean glass sampling jar, then added to a second jar to form the composite. Equal portions of water from each grab sample were poured into the composite accumulation jar. When all grabs were deposited into the accumulation jar, the sample was gently mixed; the sample pH was then adjusted to less than 2 with nitric acid. Each sample jar was covered with a Teflon-lined lid.

Eight (8) sediment grabs were collected in the same areas as the water grabs. Sediment grabs were scooped from the rocky earthen stream bed by raking a sampler, comprised of a small stainless steel beaker attached to a stainless steel pole, across each area. The grab sediment samples were then deposited in a clean stainless steel tray and stirred with a stainless steel spatula to form as uniform a composite as possible. The composite was placed in a clean glass jar covered with a Teflon-lined lid.

Both composite samples were handled via chain-of-custody handling protocols.

C. Soil Composites

Two (2) soil composites were collected at the landfill site, one (1) north and one (1) south of the NPDES discharge point; below the west face of the landfill.

The north soil composite was formed by collecting two (2) soil cores from each of five (5) locations and depositing them in a pre-cleaned Pyrex glass mixing tray. The soil was then mixed in the tray with a stainless steel spatula to form as uniform as possible a composite and placed in a sample jar. The jar housing the composite was then covered with a Teflon-lined lid and handled via chain-of-custody protocols. The south soil composite was formed and handled in the same mannor as the north composite (as described above).

TABLE III
SOIL COMPOSITE SAMPLING SITES

COMPOSITE	SAMPLING SITE
South Composite:	
Grab S1	15 feet due west and 30 feet due north of Well No. 2
Grab S2	15 feet due west and 15 feet due north of Well No. 2
Grab S3	15 feet due west of Well No. 2
Grab S4	15 feet due west and 30 feet due south of Well No. 2
Grab S5	15 feet due west and 15 feet due south of Well No. 2
North Composite:	
Grab N1	15 feet due west and 30 feet due north of Well No. 3
Grab N2	15 feet due west and 15 feet due north of Well No. 3
Grab N3	15 feet due west of Well No. 3
Grab N4	15 feet due west and 15 feet due south of Well No. 3
Grab N5	15 feet due west and 30 feet due south of Well No. 3

D. All Samples

The four (4) ground water, one (1) surface water, one (1) sediment and two (2) soil samples were each sealed by placing a chain-of-custody seal across the jar lid and down the sides of the jar. The samples were then promptly stored on ice (<$4^{O}C$). All eight (8) samples were delivered to ETC, via reliable courier, on May 12, 1989.

III. DISCUSSION OF DATA

As stipulated in the International Harvester Closure Plan, all water, sediment and soil samples were analyzed for chromium and lead content. The sediment and soil samples were also analyzed for PCB content.

All soil sample data is reported on a dry weight basis, in milligrams per kilogram ((mg/kg) or parts per million (ppm)).

A summary of all semi-annual (second quarter), third year, laboratory data is presented in Table IV; the actual laboratory report is in the Appendix of this report.

Chromium was detected in ground water from Well No. 1, the upgradient well. Ground water samples obtained from down-gradient well Nos. 2 - 4 contained no detectable levels of chromium. The 2.60 ppm chromium found in ground water collected from the upgradient well was slightly lower than the 3.24 ppm level detected in ground water that location during the previous sampling event. No lead was detected in ground water from any of the wells sampled.

No metals were detected in the surface water composite, which is comparable with data from previous sampling events conducted at this site.

Lead, Chromium, and PCBs were detected in the soil and sediment composites, but were below the average background level found in soils. These background levels can be found in Table IV.

TABLE IV
SUMMARY OF DATA

GROUND WATER MONITORING WELLS	UNITS	CHROMIUM	LEAD	PCBs
No. 1	mg/l	2.60	<0.05	-
No. 2	mg/l	<0.02	<0.05	-
No. 3	mg/l	<0.02	<0.05	-
No. 4	mg/l	<0.02	<0.05	-
NPDES Discharge Pt.				
Surface Water Comp.	mg/l	<0.02	<0.05	-
Sediment Comp.	mg/Kg*	31.4	169	0.49
Soils				
N. Landfill Comp.	mg/Kg	14.8	17.8	0.12
S. Landfill Comp.	mg/Kg	20.9	20.7	0.13
Average Background Levels				
Soil	mg/Kg	100(1)	313(2)**	<1(3)

*Millograms per kilogram = mg/kg (Dry Weight Basis).

References

(1) Allaway, W.H. 1968. Agronomic controls over the environmental cycling of trace elements. Adv. Agron. 20: 235-274.

(2) Final Report of Soil Sampling and Analysis for the North Hollywood Dump Health Effects Study, Hess Environmental Services, Inc., May 30, 1986.

Range 40.7 to 2002 mg/Kg.

(3) Richardson, B.J. and Waid, J.S. (1982). Polychlorinated biphenyls (PCBs): An Australian Viewpoint on a Global Problem. <u>Search</u> 13, 17.

IV. CONCLUSIONS

* Ground water samples collected from downgradient wells contained no significant levels of metals.

* Significant levels of chromium (consistent with previous results) were found in ground water collected form the upgradient well (Monitoring Well No. 1).

* Site surface water does not contain detectable levels of chromium or lead.

* Site soil and sediment composites do not contain contaminants of interest above published background levels.

Although the chromium concentration has decreased since the last sampling event, careful attention should continue to be given to the chromium levels detected in Monitoring Well No. 1 during future sampling events. If the level of chromium continues to remain relatively high it may be necessary to conduct a study of ground water near the upgradient well to determine the source of chromium in this area.

It would probably be advisable to survey the Measuring Point (MP) marked on the casing of each well with respect to Mean Sea Level (MSL), to varify that ground water monitoring well No. 1 is currently an upgradient well.

Aside from reporting the data contained in this report, no further action is required until the second semi-annual, third year monitoring is required.

APPENDIX
LABORATORY REPORT

RECEIVED MAY 25 1989

ENVIRONMENTAL TESTING & CONSULTING INC.
2924 WALNUT GROVE RD. • MEMPHIS, TENN 38111 • PHONE (901) 327-2750

May 24, 1989

Ms. Connie Hess, President
Hess Environmental Services
6890 Hillshire Dr., Suite 13
Memphis, Tenn. 38133

REF: ANALYTICAL TESTING
SAMPLE(S) DATE: 5/11/89
SITE 181
WATER, SOIL, SEDIMENT

Dear Ms. Hess:

The above referenced sample has been analyzed per your instructions. The tests were performed in our laboratory (#00210) in accordance with Standard Methods, 16th Edition, and the results are shown below. Testing results using SW-846, Method 8080, 3550 (PCB) are shown on the attached Organic Analysis Data Sheet.

	Lead	Chromium	
Standard Methods Page #	157	157	
By	JF	JF	
Date	5/16	5/16	
Sample ID: Water Results mg/l			
181MW1	<0.05	2.60	
181MW2	<0.05	<0.02	
181MW3	<0.05	<0.02	
181MW4	<0.05	<0.02	
181MW5	<0.05	<0.02	
181SW-1	<0.05	<0.02	
Soil Results ppm			PCB
181SW-2	169	31.4	See
181SS-1C	17.8	14.8	Attached
181SS-2C	20.7	20.9	Results

If you have any questions please call me.

Very truly yours,

Michael J. Cimbalo
President

MJC/ms

ENVIR' 'ENTAL TESTING AND CONSULT NG, INC.

RECEIVED MAY 25 1989

ORGANIC ANALYSIS DATA SHEET
PCBs

SAMPLE NAME : _HESS____________

SAMPLE ID(S) : _SITE 181________
SAMPLE DATE : _05/11/89________
DATE ARRIVED : _05/12/89________
MATRIX : _SOIL/SEDIMENT__

DATE EXTRACTED/PREPARED : _05/15/89_
DATE ANALYZED : _05/18/89_

PROJECT # : __________
INSTRUMENT ID : _V3700___
ANALYST : _LB_______

FILE NAME : _0512-001.DCC_
SAMPLE # : _0512-001______

METHOD (SW-846) : _8080_____
3550

SAMPLE ID	SAMPLE RESULTS UNITS:(mg/kg)	METHOD DETECTION LIMIT:(mg/kg)
1 SW-2	0.49	0.05
2 SS-1C	0.12	0.05
3 SS-2C	0.13	0.05

BDL - BELOW DETECTION LIMIT

Nittend Ring

Reference 19

ANNUAL REPORT OF POST CLOSURE MONITORING
AT THE
INTERNATIONAL HARVESTER LANDFILL SITE
MEMPHIS, TENNESSEE
SECOND QUARTER, SIXTH YEAR
PECI PROJECT #5222.01

PREPARED BY:
PICKERING ENVIRONMENTAL CONSULTANTS, INC.
MEMPHIS, TENNESSEE

DECEMBER 1992

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Second quarter, sixth year ground water, surface water, sediment and soil samples were collected and analyzed in compliance with post closure monitoring requirements delineated in International Harvester's Landfill Closure Plan, as enforced by the State of Tennessee.

Ground water surface elevations were measured and samples were collected from the four (4) monitoring wells on site. All ground water samples were analyzed for chromium and lead content.

Chromium was detected in the ground water sample collected from Monitoring Well No. 1, southeast of the landfill. No lead was found in ground water from monitoring Well No. 1 and no chromium or lead were found in ground water samples collected from Monitoring well Nos. 2 through 4. All current ground water data is consistent with historical data for this site.

Surface water and sediment composite samples were collected from the National Pollutant Discharge Elimination System (NPDES) discharge point on-site. No metals were detected in the surface water composite, which is consistent with data from previous sampling events; sediment data is addressed below.

Soil composite samples were collected from two (2) areas at the base of the landfill; one (1) north of the NPDES discharge point and west of the landfill and the second south of the NPDES discharge point and west of the landfill.

All sediment and soil samples were analyzed for chromium, lead and Polychlorinated Biphenyls (PCBs) content.

Lead and chromium (metals) were found in all soil and sediment composites. PCB's were found in the southern composite and the sediment composite but were not detected in the northern composite.

The levels of PCB's, lead and chromium in all soil composites were consistent with historical data.

A copy of current data is summarized in Table IV of this report.

A copy of this report should be submitted to the State. No further action should be required until second quarter, seventh year, when monitoring will again be required.

I. INTRODUCTION

The State of Tennessee, Department of Health and Environment, Division of Superfund (the State), enforces the International Harvester (IH) Landfill Closure Plan. To comply with post closure monitoring requirements delineated in that plan (and modified as noted below), Pickering Environmental Consultants, Inc. collected ground water samples from Monitoring Well Nos. 1 through 4, water and sediment samples from the NPDES discharge point and soil samples from two (2) areas at the base of the landfill.

September 12, 1989, the Pickering Firm surveyed the measuring points on each monitoring well with respect to Mean Sea Level (MSL). Ground water surface elevations were calculated based on this data.

The Closure Plan, referenced above, has been modified so that monitoring is now required on an annual basis, a reduction from the quarterly and then semi-annual monitoring required previously.

All samples were analyzed for chromium and lead content. The soil samples collected below the landfill and the sediment samples collected from the NPDES discharge point were also analyzed for PCB content.

this report addresses sampling, testing and Chain-of-Custody protocols followed to fulfill post closure monitoring requirements.

II. SAMPLE COLLECTION

On November 19, 1992, Pickering Environmental representatives collected:

* Ground water samples from Monitoring Well Nos. 1, 2, 3, and 4;

* One (1) surface water composite and one (1) sediment composite from the NPDES discharge point ditch; and,

* Two (2) soil composites; the first from below the landfill on the north side of the NPDES discharge point; and the second from below the landfill on the south side of the NPDES discharge point.

All sampling locations at the IH Landfill Site, Parcel 4, are shown in Figure I.

During this sampling event the weather was sunny and mild; the temperature was about 70 degrees F.

A. Ground Water Monitoring Wells

Each of the four (4), 2-inch ID ground water monitoring wells had a protective, metal, outer well casing with a pad-locked lid. PECI personnel found all the lids locked. Before sampling, the well depth and the depth to the surface of ground water was measured with respect to the Measuring Point (MP), in each well and the volume of standing water calculated (see Table I for these measurements).

A new disposable Teflon bailer was used to evacuate one (1) volume of standing water and three (3) volumes of recharge water from each of the Monitoring Well Nos. 1 - 4. This is in accordance with the protocol described in the Environmental Protection Agency's (EPA), <u>Resource Conservation and Recovery Act (RCRA), Ground Water Monitoring Technical Enforcement Guideline Document</u>.

The ground water samples were placed in precleaned, glass jars, and stored on ice (<4C) for preservation, immediately after collection. Ground water samples were preserved with nitric acid to a pH of less than (<) 2.

All sample container cleaning, sample preservation and analyses were performed in accordance with "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March, 1979, as referenced in the "Rules Governing Hazardous Waste Management in Tennessee" (see Table II for the specific analytical method employed for each parameter).

Established Chain-of-Custody sample handling protocols were followed. A "Field Log Book" was kept, as required in the Chain-of-Custody protocol, to record general site and weather data, as well as data collected during each sampling event. This log will be updated during each future sampling event.

All of the samples were delivered by PECI personnel on November 19, 1992, to Environmental Testing and Consulting, Inc. (ETC), a laboratory certified by the State (Certification No. 02027). ETC received all of the sample jars with the seals intact.

B. **NPDES Discharge Point**

Samples were collected at the NPDES discharge sampling point, located at the foot of the landfill, an earthen, rock laden, ditch which channels storm water runoff. This ditch is located in the northwest area of Parcel 4 (see Figure I). Water and sediment composites were collected in the vicinity of this discharge point.

PECI personnel collected grab samples of water from two (2) locations along the south bank of the ditch, near the NPDES discharge point. Water was scooped from each location via a clean glass sampling jar, then added to a second jar to form the composite. Equal portions of water from each grab sample were poured into the composite accumulation jar. When all grabs were deposited into the accumulation jar, the sample was gently mixed. The sample jar was covered with a Teflon-lined lid and handled via the same protocols for ground water.

Eight (8) sediment grabs were collected in the same general area as the water grabs. Sediment grabs were scooped from the rocky earthen stream bed by a stainless steel spoon. The grab sediment samples were then deposited in a clean Pyrex glass tray and stirred with a stainless steel spoon to form as uniform a composite as possible. The composite was placed in a clean glass jar covered with a Teflon-lined lid.

not necessary stirring only for vol. not sed.

Both composite samples were handled via Chain-of-Custody handling protocols.

C. Soil Composites

Two (2) soil composites were collected at the landfill site, one (1) north and one (1) south of the NPDES discharge point; below the west face of the landfill.

The north soil composite was formed by collecting one (1) soil core from each of nine (9) locations and depositing them in a precleaned Pyrex glass mixing tray. The soil was then mixed in the tray with a stainless steel spoon to form as uniform as possible a composite and placed in a sample jar. The jar housing the composite was then covered with a Teflon-lined lid and handled via Chain-of-Custody protocols. The south soil composite was formed by collecting one (1) soil core from each of ten (10) locations; the cores were handled in the same manner as the north composite, (described above); see Tables III-A and III-B for the locations sampled.

D. Sample Handling

The four (4) ground water, one (1) surface water, one (1) sediment and two (2) soil samples were each sealed by placing a Chain-of-Custody seal across the jar lid and down the sides of the jar. The samples were then promptly stored on ice (<4C). All eight (8) samples were delivered to ETC, via PECI personnel, on November 19, 1992, for analysis.

III. DISCUSSION OF DATA

As stipulated in the International Harvester Closure Plan, all water, sediment and soil samples were analyzed for chromium and lead content. The sediment and soil samples were also analyzed for PCB content.

All soil sample data is reported on a dry weight basis, in milligrams per kilogram ((mg/kg) or parts per million (ppm)).

A summary of all second quarter, sixth year, analytical data is presented in Table IV; a copy of the actual laboratory report is in the Appendix of this report.

Chromium was detected in ground water from Monitoring Well No. 1. The 0.19 ppm chromium level currently present in ground water from this well is consistent with recent sampling events (see Table V for a summary of historical data). Ground water samples obtained from Monitoring Well Nos. 2 through 4 contained no detectable levels of chromium. No lead was detected in ground water from any of the wells sampled. Current ground water data is comparable with historical data.

No metals were detected in the surface water composite, which is comparable with data from previous sampling events conducted at this site.

Lead and chromium were detected in all sediment and soil composites. PCB's were detected in the sediment composite and the southern soil composite.

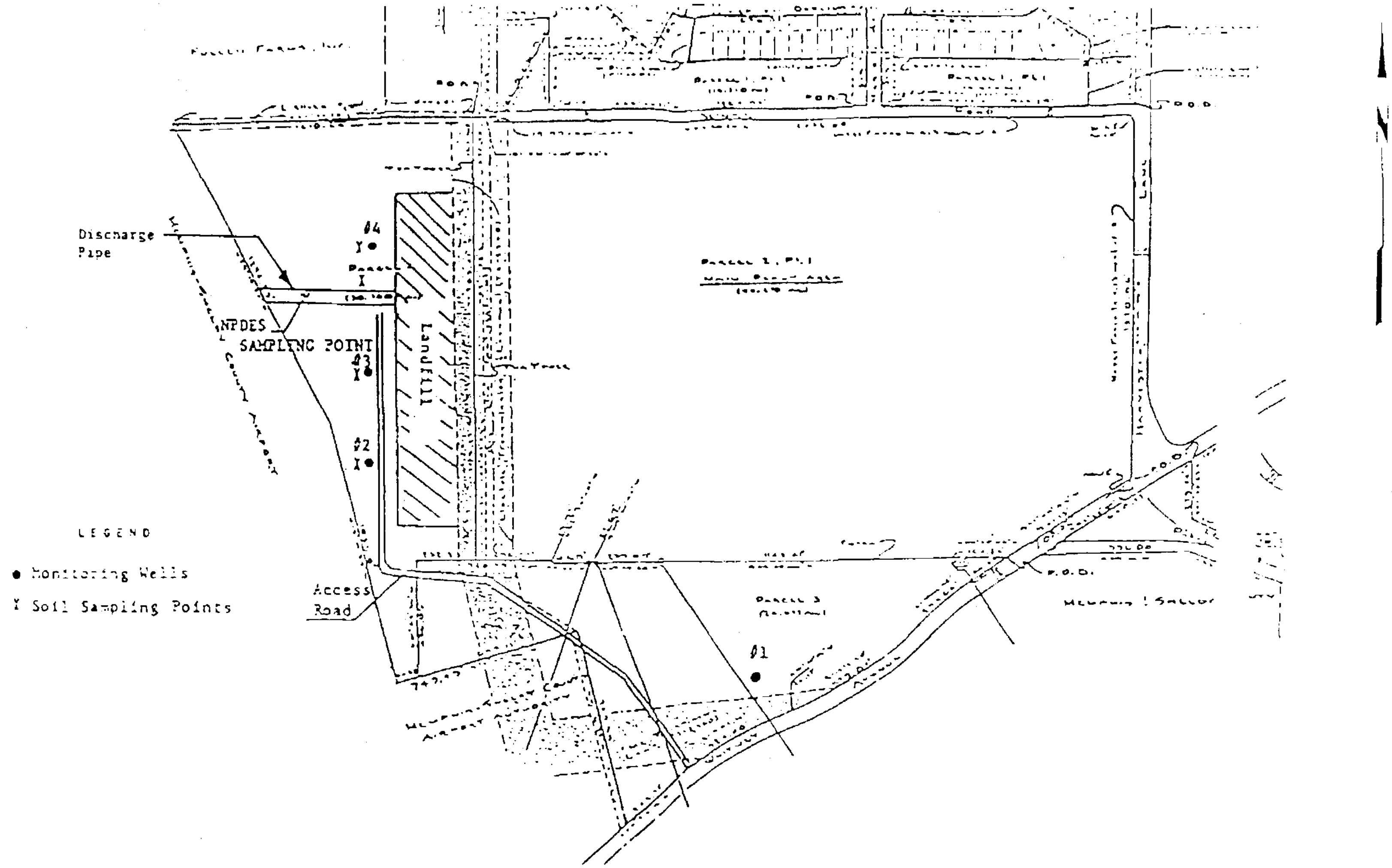
Lead, chromium, and PCB's found in the sediment and both the north and south soil composites were all consistent with historical data. (See Table V for a summary of historical data.)

IV. CONCLUSIONS

- Ground water samples collected from Monitoring Well Nos. 2 through 4 contained no significant levels of metals.
- Chromium was found in ground water collected from Monitoring Well No. 1, however this level is consistent with historical data.
- Site surface water does not contain detectable levels of chromium or lead, which is consistent with historical data.
- Site soil and sediment composites do not contain contaminants of interest above published background levels and are comparable with historical levels.

Aside from reporting the data contained in this report, no further action should be required until the second quarter, seventh year monitoring is required.

FIGURES



Title: Figure I
Subject: International Harvester
Landfill Site
Memphis, Tennessee

Pickering Environmental Consultants, Inc.
Asbestos Management
Building/Site Evaluation

TABLES

TABLE I
GROUND WATER SURFACE ELEVATION MEASUREMENTS

PARAMETER	WELL NUMBER 1	2	3	4
Total Depth of Well	41.75	24.69	24.72	25.50
Depth from MP to top of Water column	31.48	21.66	21.26	21.77
Height of water column	10.27	3.03	3.46	3.73
Measuring Point Elevations*	210.29	207.95	207.82	207.77

*Surveyed on September 12, 1989, by the Pickering Firm.

Notes: MP = Measuring Point, an area (point) at the top of each PVC well casing used as a reference point for measurements.

All measurements are in feet.

All elevations are in relation to Mean Sea Level.

TABLE II
ANALYTICAL METHODS

PARAMETERS	WATER SAMPLES METHOD REFERENCE	SOIL/ SEDIMENT SAMPLES METHOD REFERENCE
Chromium	3111 - B*	7190*
Lead	3111 - B*	7420*
PCBs	-	3550**, 8080**

* *Standard Methods for the Examination of Water and Wastewater*, 17th Edition, American Public Health Association, Inc., New York, New York.

** *Test Methods for Evaluating Solid Waste, Physical Chemistry Methods*, SW-846, Second Edition, Revised, 1985, U.S. Environmental Protection Agency.

TABLE III-A
NORTH SOIL COMPOSITE SAMPLING SITES

COMPOSITE	SAMPLING SITE
North Composite:	
Grab N1	15 feet west and 30 feet north of Well No. 4
Grab N2	15 feet west and 15 feet north of Well No. 4
Grab N3	15 feet west of Well No. 4
Grab N4	15 feet west and 30 feet south of Well No. 4
Grab N5	15 feet west and 15 feet south of Well No. 4
Grab N6	Above the drainage pipe, along the rocks surrounding the pipe, 15 feet west of the drainage pipe inlet
Grab N7	Adjacent to the drainage pipe, along the rocks surrounding the pipe, 15 feet NW of Grab N6
Grab N8	Adjacent to the drainage pipe, along the rocks surrounding the pipe, 15 feet NW of Grab N7
Grab N9	Adjacent to the drainage pipe, along the rocks surrounding the pipe, 15 feet NW of Grab N8

TABLE III-B
SOUTH SOIL COMPOSITE SAMPLING SITES

COMPOSITE	SAMPLING SITE
South Composite:	
Grab S1	15 feet west and 30 feet north of Well No. 2
Grab S2	15 feet west and 15 feet north of Well No. 2
Grab S3	15 feet west of Well No. 2
Grab S4	15 feet west and 30 feet south of Well No. 2
Grab S5	15 feet west and 15 feet south of Well No. 2
Grab S6	15 feet west and 30 feet north of Well No. 3
Grab S7	15 feet west and 15 feet north of Well No. 3
Grab S8	15 feet west of Well No. 3
Grab S9	15 feet west and 15 feet south of Well No. 3
Grab S10	15 feet west and 30 feet south of Well No. 3

TABLE IV
SUMMARY OF SECOND QUARTER, SIXTH YEAR DATA

GROUND WATER MONITORING WELLS	UNITS	CHROMIUM	LEAD	PCB'S
No. 1	*mg/L	0.19	<0.05	-
No. 2	mg/L	<0.02	<0.05	-
No. 3	mg/L	<0.02	<0.05	-
No. 4	mg/L	<0.02	<0.05	-
NPDES Discharge Pt.				
Surface Water Comp.	mg/L	<0.02	<0.05	-
Sediment Comp.	**mg/kg	17.3	30.3	0.08
Soils				
N. Landfill Comp.	mg/kg	13.2	18.5	0.02
S. Landfill Comp.	mg/kg	11.6	20.8	0.10
Average Background Levels				
Soil	mg/kg	100 (1)	***313 (2)	<1 (3)

*mg/L = milligrams per Liter
**mg/kg = milligrams per kilogram (Dry Weight Basis)
***Range 40.7 to 2002 mg/kg

References

(1) Allaway, W.H. 1968. Agronomic controls over the environmental cycling of trace elements. Adv. Agron. 20: 235-274.

(2) Final Report of Soil Sampling and Analysis for the North Hollywood Dump Health Effects Study, Hess Environmental Services, Inc., May 30, 1986.

(3) Richardson, B.J. and Waid, J.S. (1982). Polychlorinated biphenyls (PCBs): An Australian Viewpoint on a Global Problem. Search 13, 17.

TABLE V

SUMMARY OF DATA

GROUND WATER MONITORING WELLS	UNITS	CHROMIUM YEAR I I*	CHROMIUM YEAR I II	CHROMIUM YEAR I III	CHROMIUM YEAR I IV	CHROMIUM YEAR II II	CHROMIUM YEAR II IV	LEAD YEAR I I	LEAD YEAR I II	LEAD YEAR I III	LEAD YEAR I IV	LEAD YEAR II II	LEAD YEAR II IV	PCBs YEAR I I	PCBs YEAR I II	PCBs YEAR I III	PCBs YEAR I IV	PCBs YEAR II II	PCBs YEAR II IV
1	mg/l	0.24	0.58	0.02	0.68	0.63	3.24	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-
2	mg/l	<0.02	<0.02	<0.02	NS	0.04	NS	<0.05	<0.05	<0.05	NS	<0.05	NS	-	-	-	-	-	-
3	mg/l	<0.02	<0.02	<0.02	NS	0.06	NS	<0.05	<0.05	<0.05	NS	<0.05	NS	-	-	-	-	-	-
4	mg/l	<0.02	<0.02	NS	<0.02	0.11	NS	<0.05	<0.05	NS	<0.05	<0.05	NS	-	-	-	-	-	-
NPDES DISCHARGE POINT																			
Surface Water Comp.	mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-
Sediment Comp.	mg/Kg	70.2	110	144	64.6	10.3	112.5	646	191	144	161	12.2	204.5	2.97	5.1	<0.05	2.81	<0.25	2.72
SOILS																			
N. Landfill Comp.	mg/Kg	26.4	21.1	21.7	27.9	16.4	29.0	46.5	36.9	38.4	40.6	24.2	42.6	0.39	<0.25	0.64	1.28	<0.25	0.17
S. Landfill Comp.	mg/Kg	15.4	12.9	11.9	10.8	16.2	11.9	26.4	29.6	15.9	<2.5	25.3	15.8	0.41	<0.25	0.24	<0.25	<0.25	0.05
Site Background	mg/Kg	NS***	6.9	NS	NS	NS	NS	NS	44.7	NS	NS	NS	NS	NS	<0.25	NS	NS	NS	NS
Average Background	mg/Kg			100 (1)						302 (2)**						<1 (3)			

*Quarter.

**Range 40.7 to 2002 mg/Kg.

***NS = No Sample.

Soils

Res. Ind

Pb 250/500

Cr 100/500

TABLE V

SUMMARY OF DATA
(continued)

GROUND WATER MONITORING WELLS	UNITS	CHROMIUM				LEAD				PCB			
		YEAR III		YEAR IV		YEAR III		YEAR IV		YEAR III		YEAR IV	
		II*	IV	II	IV	II	IV	II	IV	II	IV	II	IV
1	mg/l	2.60	3.58	1.52	2.99	<0.05	<0.05	<0.05	<0.05		-	-	-
2	mg/l	<0.02	<0.02	<0.02	<0.02	<0.05	<0.05	<0.05	<0.05		-	-	-
3	mg/l	<0.02	<0.02	<0.02	<0.02	<0.05	<0.05	<0.05	<0.05		-	-	-
4	mg/l	<0.02	<0.02	<0.02	<0.02	<0.05	<0.05	<0.05	<0.05	-	-	-	-
NPDES DISCHARGE POINT													
Surface Water Comp.	mg/l	<0.02	<0.02	<0.02	<0.02	<0.05	<0.05	<0.05	<0.05	-	-	-	-
Sediment Comp.	mg/l	31.4	17.6	30.7	83.0	169	63.5	337	194	0.49	<0.05	12.8	<0.05
SOILS													
N. Landfill Comp.	mg/Kg	14.8	35.0	22.4	42.9	17.8	33.7	38.3	41.1	0.12	<0.05	<0.05	<0.05
S. Landfill Comp.	mg/Kg	20.9	11.3	9.10	18.9	20.7	16.5	18.0	19.4	0.13	<0.05	<0.05	<0.05
Site Background	mg/Kg	NS***	6.9	NS	NS	NS	NS	NS	44.7	NS	NS	NS	NS
Average Background	mg/Kg			100(1)				302(2)**				<1(3)	

REFERENCES:

(1) Allaway, W. H. 1968. "Argronomic Controls Over the Environmental Cycling of Trace Element," Adv. Agron. 20: 235-274.

(2) "Final Report Of Soil Sampling And Analysis For the North Hollywood Dump Health Effects Study," Hess Environmental Services, Inc., May 30, 1986.

(3) Richardson, B. J. and Wajd, J. S. (1982). "Polychlorinated Biphenyls (PCB): An Australian Viewpoint On A Global Problem," Search 13, 17.

*Quarter.

**Range 40.7 to 2002 mg/Kg.

***NS = No Sample.

TABLE V

SUMMARY OF DATA
(continued)

GROUND WATER MONITORING WELLS	UNITS	CHROMIUM YEAR V	LEAD YEAR V	PCB YEAR V
1	mg/l	2.49	<0.05	—
2	mg/l	<0.02	<0.05	—
3	mg/l	<0.02	<0.05	—
4	mg/l	<0.02	<0.05	—
NPDES DISCHARGE POINT				
Surface Water Comp.	mg/l	<0.02	<0.05	—
Sediment Comp.	mg/l	59.8	30.3	0.81
SOILS				
N. Landfill Comp.	mg/Kg	24.0	49.0	0.14
S. Landfill Comp.	mg/Kg	13.0	14.5	0.05
Site Background	mg/Kg	NS**	NS	NS
Average Background	mg/Kg	100(1)	302(2)*	<1(3)

REFERENCES:

(1) Allaway, W. H. 1968. "Argronomic Controls Over the Environmental Cycling of Trace Element," Adv. Agron. 20: 235-274.

(2) "Final Report Of Soil Sampling And Analysis For the North Hollywood Dump Health Effects Study," Hess Environmental Services, Inc., May 30, 1986.

(3) Richardson, B. J. and Wald, J. S. (1982). "Polychlorinated Biphenyls (PCB): An Australian Viewpoint On A Global Problem." Search 13, 17.

*Range 40.7 to 2002 mg/Kg.

**NS = No Sample.

SUPPLEMENTARY INFORMATION

ENVIRONMENTAL TESTING & CONSULTING, INC.
2921 Walnut Grove Road • Memphis, TN 38111 • (901) 327-2750 • FAX (901) 327-6334
Founded 1972

December 1, 1992

Mr. Ed Powell
Pickering Environmental Consultants, Inc.
1750 Madison Avenue, Suite 500
Memphis, TN 38104

REF: ANALYTICAL TESTING
SAMPLE DATE: 11/19/92
SITE ID: 5222
SAMPLE ID: SEE BELOW (AQUEOUS/SOIL)

Dear Mr. Powell:

The above referenced samples have been analyzed according to your instructions. The tests were performed in our laboratory (#02027) in accordance with Standard Methods, 17th Edition and The Solid Waste Manual, SW-846. The results are shown below and on the attached Organic Analysis Data Sheet.

Test	Results (ppm)					Method Number	Date Analyzed	By
	MW1	MW2	MW3	MW4	SW1			
Chromium	0.19	<0.02	<0.02	<0.02	<0.02	3111-B	11/30/92	BB
Lead	<0.05	<0.05	<0.05	<0.05	<0.05	3111-B	12/01/92	BB

	Soil Results (ppm)					
	North Composite	South Composite	Sediment			
Chromium	13.2	11.6	17.3	7190	11/30/92	BB
Lead	18.5	20.8	30.3	7420	12/01/92	BB
PCBs	See Attached Sheet					

Please call our office if you have any questions.

Sincerely,

Randall H. Thomas
Vice President

jw

Attachment

1119-048

ENVIRONMENTAL TESTING AND CONSULTING, INC.
MEMPHIS, TN
ORGANIC ANALYSIS DATA SHEET
PCBs

CLIENT NAME : _PICKERING ENVIRONMENTAL CONSULTANTS,INC.
SITE ID : _5222
SAMPLE DATE : _11/19/92
DATE ARRIVED : _11/19/92
MATRIX : _SOIL

PROJECT # :
ANALYST : _CC

FILE NAME : _1119-048.DOC_
SAMPLE # : _1119-048

DATE EXTRACTED/PREPARED : _11/20/92_
DATE ANALYZED : _11/20/92_

METHOD (SW-846) : _8080
3580

ETC #	SAMPLE ID	SAMPLE RESULTS UNITS:(ppm)	PCB IDENTITY	PQL (ppm)
#6	NORTH COMP	ND	NA	0.02
#7	SOUTH COMP	0.10	1248	0.02
#8	SEDIMENT	0.08	1248	0.02

PQL - PRACTICAL QUANTITATION LIMIT
ND - NONE DETECTED

LABORATORY MANAGER

CHAIN OF CUSTODY RECORD

CLIENT NAME: Pickering	PHONE: 726-0810 FAX #:	1. RELINQUISHED BY: (sign.)	DATE	TIME	RECEIVED BY: (sign.)
SITE: 5222		2. RELINQUISHED BY: (sign.)	DATE	TIME	RECEIVED BY: (sign.)
SAMPLER: (signature) Edward Powell		3. RELINQUISHED BY: (Print) Edward Powell	DATE 11/19/92	TIME 1638	RECEIVED FOR LAB BY: (Print) S. HERRMANN
FID #:	PO #:	Signature: Edward Powell			Signature: S. Herrman
REMARKS:		*** RUSH ***			
		REGULAR TURNAROUND	X		
		ICE	X		

NO. OF CON-TAIN.	SAMPLE ID NUMBER	LOCATION/DEPTH	SAMPLE DATE	TIME	SAMPLE TYPE COMP	SAMPLE TYPE GRAB	MATRIX WATER	MATRIX SOIL	MATRIX OTHER	LIST ANALYSIS BELOW: lead, chromium	PCB's							
1	5222 — MW1		11/19/92			X	X			X								
1	5222 — MW2		"			X	X			X								
1	5222 — MW3		"			X	X			X								
1	5222 — MW4		"			X	X			X								
1	5222 — SW1		"			X	X			X								
1	5222 — pier in comp.		"		^			^		X	X							
1	5222 — South comp		"		X			X		X	X							
1	5222 — sediment		11/19/92		X			X		X	X							

Reference 20

HYDROGEOLOGY AND PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR CONTAMINATION OF THE MEMPHIS AQUIFER IN THE MEMPHIS AREA, TENNESSEE

By William S. Parks

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 90-4092

Prepared in cooperation with the
CITY OF MEMPHIS,
MEMPHIS LIGHT, GAS AND WATER DIVISION

Memphis, Tennessee
1990

DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey
A-413 Federal Building
U.S. Courthouse
Nashville, Tennessee 37203

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports Section
Federal Center, Building 810
Box 25425
Denver, Colorado 80225

CONTENTS

PLATES (in pocket)

ILLUSTRATIONS

TABLES

CONVERSION FACTORS AND DEFINITIONS

Factors for converting inch-pound units to metric units are shown to four significant digits:

Multiply inch-pound units	By	To obtain metric units
inch (in.)	2.540	centimeter (cm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi^2)	2.590	square kilometer (km^2)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m^3/s)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Well-Numbering System: Wells are identified according to the numbering system used by the U.S. Geological Survey (USGS) throughout Tennessee. The well number consists of three parts: (1) an abbreviation of the name of the county in which the well is located; (2) a letter designating the USGS 7 1/2-minute topographic quadrangle on which the well is plotted; and (3) a number generally indicating the numerical order in which the well was inventoried. The well number Sh:K-141, for example, indicates that the well is located in Shelby County on the "K" quadrangle and is identified as well 141 in the numerical sequence. Quadrangles are lettered from left to right, beginning in the southwest corner of the county. In this report, wells in Crittenden County, Ark., and DeSoto County, Miss., are numbered using the prefixes "Ar:" and "Ms:" for the preparation of illustrations. The suffixes (for example, "A-7") for the wells in DeSoto County are the same as the well designations assigned by the USGS in Mississippi.

HYDROGEOLOGY AND PRELIMINARY ASSESSMENT OF THE POTENTIAL FOR CONTAMINATION OF THE MEMPHIS AQUIFER IN THE MEMPHIS AREA, TENNESSEE

By William S. Parks

ABSTRACT

Detailed maps of the thickness of the Jackson-upper Claiborne confining unit and the altitude of the water table in the alluvium and fluvial deposits provide much new information concerning areas where downward leakage is or may be occurring from the water-table aquifers to the Memphis aquifer in the Memphis area. A detailed map of the altitude of the potentiometric surface of the Memphis aquifer and the locations of 44 sites where contaminants have been detected in the water-table aquifers indicate that many of these sites are located in areas where the direction of ground-water flow in the Memphis aquifer is toward municipal well fields. Consequently, if contaminants enter the Memphis aquifer, a hydraulic potential exists for their transport to those well fields.

Recently (1986-88), volatile organic compounds were detected in water from five municipal wells screened in the Memphis aquifer—three in the Allen well field of the Memphis Light, Gas and Water Division at Memphis and two in the west well field at Collierville. Concentrations of seven volatile organic compounds totaled about 11 micrograms per liter in a sample from one well in the Allen well field at Memphis, and the concentration of one compound was 25 micrograms per liter in a sample from one well at Collierville. These are the first reported occurrences of synthetic organic compounds in the Memphis aquifer and prove that the principal aquifer in the Memphis area is vulnerable to contamination.

INTRODUCTION

The City of Memphis presently (1989) depends solely on the Memphis aquifer for its water supply. Withdrawals from this aquifer in the Memphis area for municipal, industrial, and commercial uses were about 200 Mgal/d in 1988. Historically, the Memphis aquifer was thought of as an ideal artesian aquifer overlain by a thick, impermeable clay layer that serves as an upper confining unit and protects it from contamination from near-surface sources. Studies made over the past few decades, however, indicate that the confining unit locally is thin or absent or contains sand "windows" that could provide "pathways" for contaminants to reach the Memphis aquifer (Criner and others, 1964; Bell and Nyman, 1968; Parks and Lounsbury, 1976; Graham and Parks, 1986).

Other studies indicate that downward leakage from the water-table aquifers to the Memphis aquifer is widespread in the Memphis area (Graham and Parks, 1986; J.V. Brahana and

R.E. Broshears, USGS, written commun., 1987). Areas particularly susceptible to leakage are places where the confining unit is thin or absent and in the vicinity of the Memphis Light, Gas and Water Division (MLGW) well fields where leakage is accelerated as a result of pumping stress in the Memphis aquifer (Graham and Parks, 1986).

Recently, volatile organic compounds were detected in water from five municipal wells pumping from the Memphis aquifer--three in the MLGW Allen well field at Memphis (J.H. Webb, MLGW, oral commun., 1986-88) and two in the west well field at Collierville (J.L. Ashner, Tennessee Department of Health and Environment (TDHE), oral commun., 1986). These are the first reported occurrences of synthetic organic compounds in the Memphis aquifer and prove that the principal aquifer in the Memphis area is vulnerable to contamination.

The concerns about the effectiveness of the confining unit to protect the Memphis aquifer prompted the City of Memphis, MLGW, and the U.S. Geological Survey (USGS) in 1987 to initiate a cooperative investigation of the potential for contamination of the aquifer. This report summarizes the findings of the investigation.

Purpose and Scope

The objectives of this investigation were to: (1) prepare detailed maps of the thickness of the Jackson-upper Claiborne confining unit, the water table in the alluvium and fluvial deposits, and the potentiometric surface of the Memphis aquifer; (2) identify potential sources of contamination of the Memphis aquifer; (3) update knowledge of indications of downward leakage from the water-table aquifers to the Memphis aquifer; and (4) make a preliminary assessment of the potential for contamination of the Memphis aquifer.

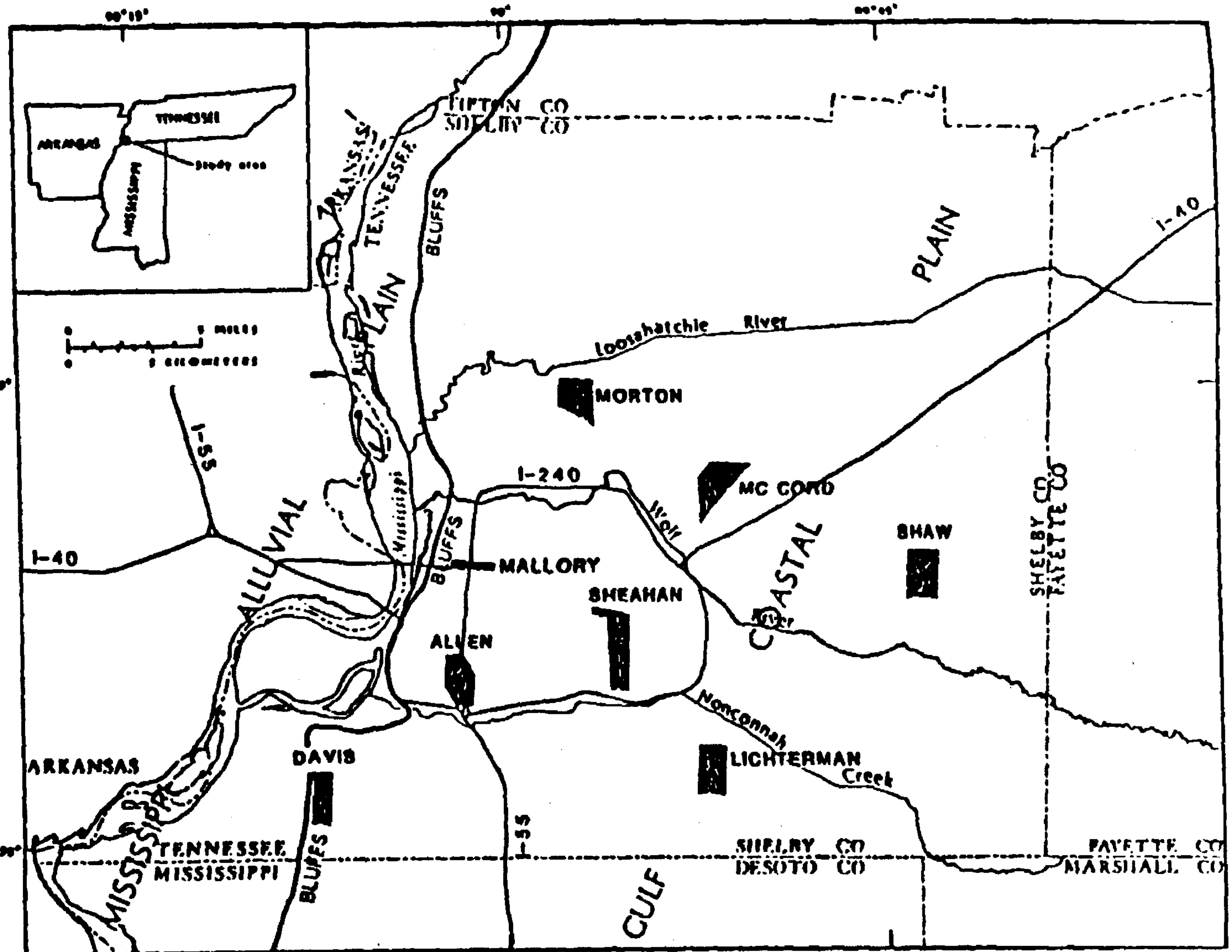
The investigation was limited to the Memphis area, as defined in recent reports (about 1,500 square miles), which includes all of Shelby County and parts of Fayette and Tipton Counties, Tenn., DeSoto and Marshall Counties, Miss., and Crittenden and Mississippi Counties, Ark. (fig. 1). Emphasis was placed on Shelby County, Tenn., where most of the municipal well fields are located (fig. 1).

Tasks included in the investigation were to: (1) interpret and correlate geophysical logs selected from a USGS file of more than 500 logs, (2) measure water levels in about 140 wells in the water-table and Memphis aquifers, (3) search for historic water levels in the USGS and State files to supplement data for the water-table aquifers, (4) collect information from various regulatory agencies relative to the location and type of potential sources of contamination of the Memphis aquifer, and (5) prepare interpretive maps and the final report.

Previous Investigations

Many previous reports include information concerning the local and regional aspects of the aquifer systems in the Memphis area, and many others contain water-level and water-quality data. Consequently, this discussion of previous investigations is limited to primary sources of information concerning the hydrology, geology, water levels, and water quality of the principal aquifers and associated environmental concerns. This report and primary previous reports contain lists of references that provide additional information sources. Extensive lists of selected references (although not all inclusive) are given in reports by Graham and Parks (1986) and Brahana and others (1987).

The hydrology and general geology of the principal aquifers are described in reports by Safford (1890), Glenn (1906), Wells (1931, 1933), Kazmann (1944), Schneider and Cushing



Base from U.S. Geological Survey 1:24,000 and Mississippi River Commission 1:62,500 quadrangles

EXPLANATION

DAVIS — MEMPHIS LIGHT, GAS AND WATER DIVISION WELL FIELD

—— PHYSIOGRAPHIC BOUNDARY

Figure 1.--Major physiographic subdivisions in the Memphis area and

(1948), Criner and Armstrong (1958), Plebuch (1961), Criner and others (1964), Nyman (1965), Bell and Nyman (1968), and Dalsin and Bettandorff (1976). Parks (1973, 1975, 1977, 1978, 1979a, 1979b, 1987a) mapped and described the surface and shallow subsurface geology of the Memphis urban area.

A series of potentiometric-surface maps and graphs showing historic water-level changes and pumpage (1886-1975) from the Memphis and Fort Pillow aquifers are included in a report by Criner and Parks (1976). The potentiometric surface of the Memphis aquifer in August 1978 was given by Graham (1979). Graham (1982) updated pumpage and water-level information for the Memphis and Fort Pillow aquifers through 1980 and included a map of the potentiometric surface of the Memphis aquifer for September 1980. The altitude of the water table in the alluvium and fluvial deposits and the potentiometric surfaces of the Memphis and Fort Pillow aquifers in the Memphis urban area for the fall 1984 are included in a report by Graham and Parks (1986).

A two-dimensional digital computer flow model of the Memphis aquifer was described by Brahana (1982). The application of this model as a predictive tool to estimate aquifer response to various hypothetical pumpage projections was described by Brahana and included in the U.S. Army Corps of Engineers, Memphis Metropolitan Urban Water Resources Study (1981). Brahana and Brosbears (USGS, written commun., 1987) described the hydrologic framework of the Memphis area and documented the development of an integrated conceptual model of the ground-water flow and testing of this conceptual model through application of a multilayer finite-difference flow model.

Information concerning quality of water in the principal aquifers in the Memphis area is in reports by Wells (1933), Schneider and Cushing (1948), Lanphere (1955), Criner and Armstrong (1958), Plebuch (1961), Criner and others (1964), Bell and Nyman (1968), and Dalsin and Bettandorff (1976). Graham (1982) summarized the quality of water in the principal aquifers and discussed the potential for contamination of the aquifers. A report by Parks and others (1982) describes the installation and sampling of observation wells at six abandoned or inactive dumps in the Memphis area and provides data on the quality of water in the water-table aquifers at these sites. Graham (1985) described the installation and sampling of additional wells at the North Hollywood Dump and gave a summary of the quality of water in the water-table aquifers in the area of the dump.

Brahana and others (1987) provided background information concerning the quality of natural, uncontaminated water from the principal aquifers in the Memphis area, including tables summarizing the minimum, median, and maximum concentrations of selected major and trace inorganic constituents. This report also summarizes water-quality data for the MLGW well fields. McMaster and Parks (1988) provided background information concerning concentrations of selected trace inorganic constituents and synthetic organic compounds in the water-table aquifers. This report summarizes the results of previous investigations that give information concerning quality of water in the water-table aquifers.

A summary of some current and possible future environmental problems related to geology and hydrology in the Memphis area is given in a report by Parks and Lounsbury (1976). Rima (1979) discussed the susceptibility of the Memphis ground-water supply to contamination from a pesticide waste-disposal site in northeastern Hardeman County, Tenn. Graham and Parks (1986) described the potential for leakage among the principal aquifers in the Memphis area and provided information to support the fact that downward leakage from the water-table aquifers to the Memphis aquifer is widespread.

They also summarize information from previous investigations documenting downward leakage. Parks (1987b) summarized indications of downward leakage from the water-table aquifers to the principal artesian aquifer (Memphis aquifer) at Memphis.

Acknowledgments

Acknowledgments are due many individuals who contributed information or provided assistance during this investigation, particularly in regard to the identification of potential sources of contamination and the measurement of water levels. Early in the investigation, Ms. Jennifer L. Ashner, formerly with the TDHE, Division of Solid Waste Management (DSWM), provided information about sites under investigation in Shelby County, Tenn. Later, Mr. John Fox, Jr., with the TDHE, Division of Ground Water Protection (DGWP), provided lists of 1,679 underground storage tanks in Shelby County, Tenn. Before water-level measurements were made, Mr. James C. Ozment, then with the DGWP, provided information concerning investigations of underground storage tanks in Shelby County where wells installed in the water-table aquifers were available for measurement. Ms. Gwynne A. Woodward of the DSWM provided information on wells in the water-table aquifers at landfills and other sites under investigation and assisted in measuring water levels at many sites. Messrs. Fred P. Von Hofe and William J. Cole, MLGW, arranged to turn off many wells in the Memphis aquifer in the MLGW well fields during a high water-demand period and provided personnel to make airline measurements in the wells. Mr. Ozment, with the TDHE Underground Storage Tank Program, also reviewed the files of underground-storage-tank investigations and identified sites where the water-table aquifers are contaminated. Mr. J. Paul Patterson and Ms. Woodward of the DSWM provided information about contamination of the water-table aquifers at several sites under investigation. Ms. Betty J. Maness and Mr. W. Jordan English of the TDHE, Division of Superfund, reviewed a list and identified sites where contaminants have been detected in the water-table aquifers and provided water-quality analyses for these sites and the two contaminated wells screened in the Memphis aquifer at Collierville. Mr. R.R. Franklin of the U.S. Environmental Protection Agency (U.S. EPA) provided information concerning the Gallaway pits. Mr. James H. Webb, MLGW, provided information concerning contaminants that have been detected in water from wells screened in the Memphis aquifer in the Allen well field.

PHYSIOGRAPHIC SETTING

The Memphis area is situated in two major physiographic subdivisions (fig. 1). The eastern three-quarters of the area is in the Gulf Coastal Plain section and the western one-quarter is in the Mississippi Alluvial Plain section of the Coastal Plain physiographic province (Fenneman, 1938). The principal river in the area is the Mississippi River; the major tributaries are the Wolf River, the Loosahatchie River, and Nonconnah Creek.

The Gulf Coastal Plain is characterized by gently rolling to steep topography formed as a result of erosion of geologic formations of Quaternary and Tertiary age. During the later stages of Pleistocene glaciation, this topography was covered by a relatively thick blanket of loess that makes up the present land surface. The gently rolling to steep topography is broken in many places by the flat-lying alluvial plains of streams crossing the area. Perhaps the most distinctive feature of the Gulf Coastal Plain is the loess covered bluffs that rise abruptly above the Mississippi Alluvial Plain at its eastern boundary. Land-surface altitudes in the Gulf Coastal Plain are as low as 190 feet above sea level at the mouth of Nonconnah Creek in southwestern

Shelby County, Tenn., and are as high as 470 feet above sea level in southwestern Fayette County, Tenn. Maximum local relief between the Gulf Coastal Plain and the Mississippi Alluvial Plain is about 200 feet along the bluffs in northwestern Shelby County.

The Mississippi Alluvial Plain is flat lying and is characterized by features of fluvial deposition such as point bars, abandoned channels, and natural levees. Land-surface altitudes are as low as 180 feet above sea level on the banks of the Mississippi River in extreme northwestern DeSoto County, Miss., and as high as 230 feet above sea level adjacent to the bluffs in southwestern Tipton County, Tenn. Maximum local relief commonly is not more than 10 or 20 feet, except where the Mississippi Alluvial Plain is built up above flood levels by man-placed fill.

HYDROGEOLOGY

The Memphis area is located in the north-central part of the Mississippi embayment, a broad structural trough or syncline that plunges southward along an axis that approximates the Mississippi River (Cushing and others, 1964). This syncline is filled with a few thousand feet of unconsolidated to semiconsolidated sediments that make up formations of Cretaceous and Tertiary age. These formations dip gently westward into the embayment and southward down the axis. Overlying the Cretaceous and Tertiary formations in many areas are the fluvial deposits (terrace deposits), loess, and alluvium of Tertiary(?) and Quaternary age. Descriptions of the post-Wilcox Group geologic units and their hydrologic significance in the Memphis area are given in table 1.

Table 1.–*Post-Wilcox Group geologic units underlying the Memphis area and their hydrologic significance*

[Modified from Graham and Parks, 1986]

System	Series	Group	Stratigraphic unit	Thickness, in feet	Lithology and hydrologic significance
Quaternary	Holocene and Pleistocene		Alluvium	0-175	Sand, gravel, silt, and clay. Underlies the Mississippi Alluvial Plain and alluvial plains of streams in the Gulf Coastal Plain. Thickest beneath the Alluvial Plain, where commonly between 100 and 150 feet thick; generally less than 50 feet thick elsewhere. Provides water to domestic, farm, industrial, and irrigation wells in the Mississippi Alluvial Plain.
	Pleistocene		Loess	0-65	Silt, silty clay, and minor sand. Principal unit at the surface in upland areas of the Gulf Coastal Plain. Thickest on the bluffs that border the Mississippi Alluvial Plain; thinner eastward from the bluffs. Tends to retard downward movement of water providing recharge to the fluvial deposits.
Quaternary and Tertiary(?)	Pleistocene and Pliocene(?)		Fluvial deposits (terrace deposits)	0-100	Sand, gravel, minor clay and ferruginous sandstone. Generally underlie the loess in upland areas, but are locally absent. Thickness varies greatly because of erosional surfaces at top and base. Provides water to many domestic and farm wells in rural areas.
Tertiary	Eocene	?	Jackson Formation and upper part of Claiborne Group, includes Cockfield and Cook Mountain Formations ("capping clay")	0-375	Clay, silt, sand, and lignite. Because of similarities in lithology, the Jackson Formation and upper part of the Claiborne Group cannot be reliably subdivided areally based on present work. Most of the preserved sequence consists of the Cockfield and Cook Mountain Formations, but the Jackson Formation occurs beneath the higher hills and ridges in the northern part of the Memphis area. Serves as the upper confining unit for the Memphis aquifer.
		Claiborne	Memphis Sand ("500-foot" sand)	500-890	Sand, clay, and minor lignite. Thick body of sand with lenses of clay at various stratigraphic horizons and minor lignite. Thickest in the southwestern part of the Memphis area; thinnest in the northeastern part. Principal aquifer providing water for municipal and industrial supplies east of the Mississippi River; sole source of water for the City of Memphis. Underlain by the Flour Island Formation of the Wilcox Group, which serves as the lower confining unit for the Memphis aquifer.

Hydrogeologic units considered in this report (discussed in descending order of age) are: (1) the alluvium and fluvial deposits that comprise the shallow water-table aquifers, (2) the Jackson Formation and the Cockfield and Cook Mountain Formations in the upper part of the Claiborne Group that comprise the Jackson-upper Claiborne confining unit, and (3) the Memphis Sand that comprises the Memphis aquifer. Hydrogeologic sections showing the principal aquifers and confining units in the Memphis area are given in figure 2.

The alluvium occurs beneath the Mississippi Alluvial Plain and alluvial plains of streams draining the Gulf Coastal Plain (fig. 1) and consists primarily of sand, gravel, silt, and clay. The unit generally consists of fine sand, silt, and clay in the upper part, and sand and gravel in the lower part. The alluvium ranges from 0 to 175 feet in thickness. It commonly is about 100 to 150 feet thick beneath the Mississippi Alluvial Plain and less than 50 feet thick beneath the alluvial plains of major streams draining the Gulf Coastal Plain. The alluvium supplies water to many domestic, farm, industrial, and irrigation wells in the Mississippi Alluvial Plain.

The fluvial deposits occur beneath the uplands and valley slopes of the Gulf Coastal Plain (fig. 1) and consist primarily of sand, gravel and minor clay lenses. Locally, the sand and gravel is cemented with iron oxide to form thin layers of ferruginous sandstone or conglomerate in the lower or basal parts. The fluvial deposits range from 0 to 100 feet in thickness. Thickness varies because of erosional surfaces at both the top and base of the unit. The fluvial deposits provide water to many domestic and farm wells in rural areas of the Gulf Coastal Plain.

Because of the lithologic similarities of the Jackson, Cockfield, and Cook Mountain Formations and upper part of the Memphis Sand, a detailed study of the stratigraphy and geologic structure would be needed to correlate the units on the many geophysical logs available for wells and test holes drilled in the Memphis area. Such a study is beyond the scope of the present investigation. For the Gulf Coast Regional Aquifer-System Analysis (GC RASA) investigation (Grubb, 1984), however, the Jackson, Cockfield, and Cook Mountain Formations were correlated and mapped regionally in the subsurface of western Tennessee and the occurrence of these units was extended into the Memphis area (Parks and Carmichael, 1990a,b). From the GC-RASA work and additional observations made during the present investigation, some generalizations can be made concerning the occurrence of these units.

The Jackson Formation, which was once thought to comprise most of the thickness of the confining unit separating the water-table aquifers from the Memphis aquifer, occurs only beneath the higher hills and ridges in the northern part of the Memphis area. Based on geophysical-log correlations, this unit consists generally of fine sand or sandy clay and ranges from 0 to about 50 feet in thickness. The Jackson Formation (Tennessee, Kentucky, and Missouri) and the Jackson Group (Mississippi, Arkansas, Louisiana, and Texas) overlies the Cockfield Formation (Yegua Formation in Texas) and is part of a thick regional confining unit for the Cockfield aquifer (Hosman, 1988). In the Memphis area, the Jackson Formation is included in the upper part of the Jackson-upper Claiborne confining unit.

The Cockfield Formation occurs in the subsurface in most of the Memphis area, extending eastward at places nearly to the approximate eastern limits of the Jackson-upper Claiborne confining unit (plate 1). The Cockfield Formation consists of interfingering fine sand, silt, clay, and local lenses of lignite. The unit ranges from 0 to about 250 feet in thickness. In most of the Memphis area, the formation is an erosional remnant, and the original thickness is preserved

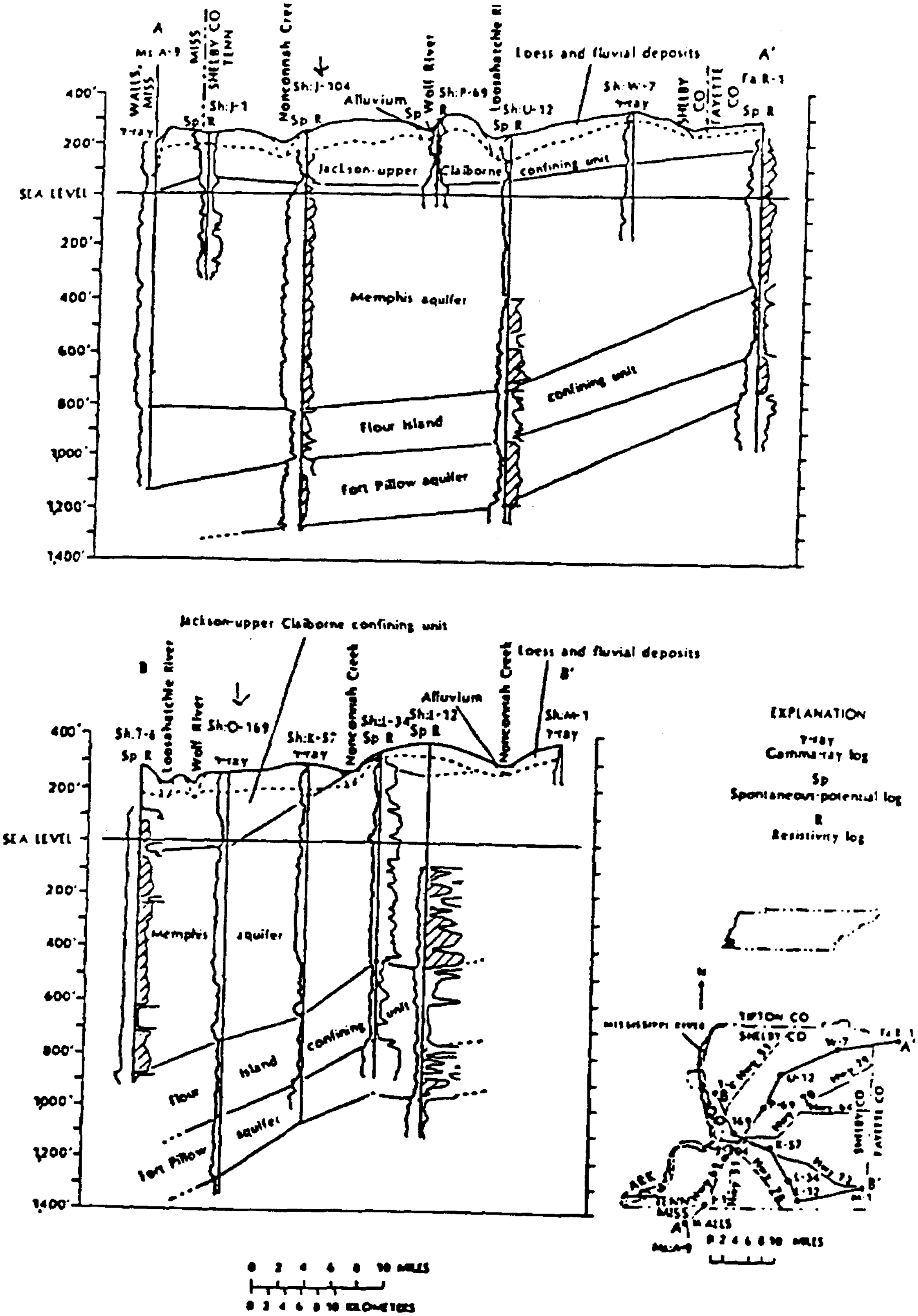


Figure 2.--Hydrogeologic sections showing the principal aquifers and confining units in the Memphis area (Modified from Graham and Parks, 1986.)

only beneath the higher hills and ridges in the northern part. The discontinuous and interconnected sands of the Cockfield Formation constitute a regional aquifer in some parts of the area of occurrence in Tennessee, Kentucky, Missouri, Arkansas, Louisiana, Texas (Yegua Formation), and Mississippi (Hosman, 1988). In the Memphis area, the Cockfield Formation consists predominantly of fine sediments and lacks the thicker, coarser sands present in other areas. Consequently, the formation is included in the Jackson-upper Claiborne confining unit. A few domestic wells in the Memphis area are screened in sands in the Cockfield Formation.

The Cook Mountain Formation occurs in the subsurface of most of the Memphis area, extending eastward to the approximate eastern limits of the Jackson-upper Claiborne confining unit (plate 1). The Cook Mountain Formation consists primarily of clay, but it locally contains varying amounts of fine sand. The formation ranges from about 30 to 150 feet in thickness, but it is commonly about 60 to 70 feet thick. The Cook Mountain Formation is a regional confining unit overlying the Memphis Sand in Tennessee, Missouri, and northeastern Arkansas and the Sparta Sand in Kentucky, southern Arkansas, Louisiana, and Mississippi (Hosman, 1988). In the Memphis area, the formation is the most persistent clay layer in the Jackson-upper Claiborne confining unit.

The Memphis Sand occurs in the subsurface of all of the Memphis area. Eastward from the approximate eastern limits of the Jackson-upper Claiborne confining unit (plate 1), the eroded upper part of the Memphis Sand directly underlies the alluvium and fluvial deposits. The Memphis Sand consists primarily of a thick body of sand that includes subordinate lenses of clay and silt at various horizons and ranges from about 500 to 900 feet in thickness. The Memphis Sand (and its equivalents) is a regional aquifer in Tennessee, Missouri, Kentucky (Tallahatta Formation and Sparta Sand), and northeastern Arkansas. The Memphis Sand is equivalent to (in ascending order) the Tallahatta Formation, Winona Sand, Zilpha Clay, and Sparta Sand of northern Mississippi and the Carrizo Sand, Cane River Formation, and Sparta Sand of southern Arkansas (Hosman, 1988). In the Memphis area, the Memphis aquifer provides water for most municipal, industrial, and commercial supplies.

Thickness of the Confining Unit Overlying the Memphis Aquifer

The thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet are shown in plate 1. This map was prepared by interpretation and correlation of 236 geophysical logs made primarily in test holes for water wells or through the casings of observation wells and abandoned water wells. These logs were selected from a file of more than 500 electric and gamma-ray logs made by the USGS in the Memphis area from the early 1950's to 1989. Most of the logs in the file were examined during this investigation. Because many of the geophysical logs were made in test holes drilled at MLGW and industrial well fields, the logs used for making the map were selected on the basis of well spacing and, when a choice could be made, on the basis of the quality of the log. Through the years, wells were drilled on some MLGW well field lots to both the Memphis and Fort Pillow aquifers or to replace wells in the Memphis aquifer to about the same or greater depths. Thus, the file may contain as many as three logs for wells on the same well lots. In addition, lots in MLGW well fields are commonly about 1,000 feet apart, necessitating a further selection of logs based on well spacing for the scale of the map. Interpretive information from the geophysical logs used to prepare the map showing the thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet (plate 1) are given in table 2.

Table 2.--*Thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet in the Memphis area*--Continued

Well No.	Lati-tude	Longi-tude	Alti-tude	Base of water-table aquifer	Base of Cook Mountain Formation	Thickness of confining unit	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Aggregate thicknesses of clay beds
Sh:J-38	350711	0900107	315	97	238	141	109	238	129	..	..	..	129
Sh:J-41	350723	0900213	275	49	248	199	82	116	34	185	248	63	97
Sh:J-47	350508	0900459	230	94	226	132	94	108	14	154	226	72	86
Sh:J-49	350611	0900344	280	75	277	202	112	141	29	149	189	40	
							220	243	23	260	277	17	109
Sh:J-50	350411	0900416	241	54	187	133	104	187	83	..	..	..	83
Sh:J-59	350402	0900513	241	104	189	85	104	189	85	..	..	..	85
Sh:J-62	350459	0900330	223	45	183	138	45	76	31	89	183	94	125
Sh:J-65	350232	0900249	303	94	205	111	94	132	38	145	205	60	98
Sh:J-71	350206	0900212	295	97	165	68	97	108	11	115	165	50	61
Sh:J-74	350022	0900117	303	65	140	75	72	140	68	..	..	..	68
Sh:J-83	350319	0900144	280	45	167	122	45	95	50	112	144	32	82
Sh:J-84	350536	0900627	243	168	197	29	168	186	18	..	..	..	18
Sh:J-104	350537	0900145	248	82	202	120	117	202	85	..	..	..	85
Sh:J-111	350503	0900132	280	114	240	126	114	128	14	140	240	100	114
Sh:J-113	350449	0900136	272	85	174	89	85	174	89	..	..	..	89
Sh:J-115	350553	0900223	295	101	262	161	101	119	18	131	262	131	149
Sh:J-119	350521	0900204	280	98	180	82	112	180	68	..	..	..	68
Sh:J-127	350438	0900136	245	40	168	128	40	57	17	65	79	14	
							88	168	80	..	..	..	111
Sh:J-129	350353	0900040	290	103	249	146	103	160	57	180	249	69	126
Sh:J-133	350653	0900119	300	88	310	222	88	164	76	230	310	80	156
Sh:J-138	350148	0900702	300	84	242	158	162	242	80	..	..	..	80
Sh:J-144	350053	0900708	280	96	204	108	136	204	68	..	..	..	68
Sh:J-166	350611	0900205	278	100	210	110	130	210	80	..	..	..	80
Sh:K-13	350541	0895902	295	80	224	144	117	224	107	..	..	..	107
Sh:K-18	350523	0895801	293	55	206	151	55	110	55	132	206	74	129
Sh:K-23	350647	0895420	320	112	220	108	112	136	24	161	198	37	
							204	220	16	..	..	..	77
Sh:K-28	350111	0895905	320	36	150	114	88	117	29	123	150	27	56
Sh:K-29	350258	0895920	271	58	94	36	58	94	36	..	..	..	36
Sh:K-31	350143	0895357	317	27	52	25	27	52	25	..	..	..	25
Sh:K-33	350545	0895925	275	65	210	145	65	102	37	110	210	100	137
Sh:K-72	350509	0895553	252	44	150	106	44	150	106	..	..	..	106
Sh:K-79	350024	0895827	350	38	172	136	38	68	30	85	172	87	117
Sh:K-81	350103	0895719	380	44	184	140	44	86	42	99	184	85	127
Sh:K-88	350633	0895430	313	83	176	93	128	176	48	..	..	..	48
Sh:K-90	350627	0895533	285	92	118	26	105	118	13	..	..	..	13
Sh:K-104	350151	0895340	300	32	37	5	32	37	5	..	..	..	5
Sh:K-108	350153	0895259	295	24	74	50	24	74	50	..	..	..	50
Sh:K-109	350532	0895553	258	66	194	128	66	84	18	119	194	75	93
Sh:K-114	350205	0895341	302	21	47	26	21	47	26	..	..	..	26
Sh:K-115	350300	0895347	273	92	170	78	92	102	10	132	170	38	48

Table 2.--*Thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet in the Memphis area*

[Latitude and longitude are in degrees, minutes, and seconds; altitude is in feet above sea level; base of water-table aquifer, base of Cook Mountain Formation, and tops and bottoms of clay beds are depths in feet below land surface; thicknesses are in feet; dashes (--) indicate no data given for any clay beds below base of the Cook Mountain Formation]

Well No.	Latitude	Longitude	Altitude	Base of water-table aquifer	Base of Cook Mountain Formation	Thickness of confining unit	Clay bed top	Clay bed bottom	Clay bed thickness	Clay bed top	Clay bed bottom	Clay bed thickness	Aggregate thicknesses of clay beds
Ar:C-1	350959	0901738	209	148	288	140	172	204	32	220	288	68	100
Ar:E-2	350519	0901810	207	102	313	211	102	142	40	256	313	57	97
Ar:H-2	350344	0901300	211	90	266	176	90	120	30	162	266	104	134
Ar:H-4	350724	0901347	214	154	272	118	190	272	82	--	--	--	82
Ar:N-1	350849	0900928	211	84	182	98	84	99	15	110	182	72	87
Ar:O-1	351349	0900828	217	105	302	197	105	120	15	126	167	41	
							223	302	79	--	--	--	135
Ar:O-2	350745	0900553	227	99	227	128	99	131	32	150	227	77	109
Ms:A-7	345919	0900826	220	57	150	93	74	150	76	--	--	--	76
Ms:A-9	345731	0900911	211	127	204	77	134	204	70	--	--	--	70
Ms:A-12	345712	0900915	210	117	198	81	117	198	81	--	--	--	81
Ms:A-20	348748	0900629	302	78	318	240	130	140	10	178	204	26	
							242	318	76	--	--	--	112
Ms:A-103	345737	0901026	211	124	226	102	124	226	102	--	--	--	102
Ms:B-5	345835	0900054	325	60	177	117	90	177	87	--	--	--	87
Ms:B-6	345740	0895945	335	49	161	112	104	161	57	--	--	--	57
Ms:B-7	345917	0900100	305	28	123	95	40	54	14	77	113	36	50
Ms:B-63	345657	0900311	289	86	172	86	86	172	86	--	--	--	86
Ms:C-4	345817	0895712	373	50	147	97	119	147	28	--	--	--	28
Ms:C-15	345812	0895851	345	40	198	158	98	198	100	--	--	--	100
Ms:C-17	345805	0895400	402	56	66	10	56	66	10	--	--	--	10
Ms:D-3	345747	0894943	391	53	124	71	53	124	71	--	--	--	71
Ms:D-28	345903	0894741	402	61	82	21	61	82	21	--	--	--	21
Ms:D-46	345709	0895014	412	51	174	123	51	84	33	98	174	76	109
Ms:D-57	345620	0895142	390	36	101	65	36	101	65	--	--	--	65
Fa:R-1	352226	0893301	318	40	122	82	40	122	82	--	--	--	82
Sh:E-3	345842	0895221	335	24	65	41	24	65	41	--	--	--	41
Sh:E-4	345943	0894802	403	76	153	77	76	87	11	101	163	52	63
Sh:H-1	350331	0900729	312	110	270	160	134	270	136	--	--	--	136
Sh:H-2	350405	0900738	215	94	201	107	94	201	107	--	--	--	107
Sh:H-8	350157	0900742	305	84	246	162	138	164	26	181	246	65	91
Sh:H-11	350115	0900740	274	50	191	141	50	65	15	86	102	16	
							139	191	52	--	--	--	83
Sh:H-13	350452	0900759	238	114	198	84	123	175	52	185	198	13	65
Sh:J-1	350004	0900546	240	50	162	112	50	68	16	76	162	86	102
Sh:J-10	350501	0900239	270	104	214	110	104	214	110	--	--	--	110
Sh:J-27	350716	0900330	268	60	265	205	60	107	47	202	265	63	110
Sh:J-32	350657	0900428	280	122	262	140	122	139	17	197	262	65	82

Table 2.--*Thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet in the Memphis area*--Continued

Well No.	Lati-tude	Longi-tude	Alti-tude	Base of water-table aquifer	Base of Cook Mountain Formation	Thickness of confining unit	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Aggregate thicknesses of clay beds
Sh:K-120	350008	0895450	362	29	133	104	46	63	17	83	133	50	67
Sh:K-122	350434	0895739	240	33	155	122	33	155	122	--	--	--	122
Sh:K-125	350114	0895822	311	26	138	112	54	72	18	104	138	34	52
Sh:K-127	350024	0895838	320	36	178	142	60	81	21	107	178	71	92
Sh:K-139	350810	0895528	295	96	120	24	102	120	18	--	--	--	18
Sh:K-141	350724	0895553	311	106	176	70	121	176	55	--	--	--	55
Sh:K-142	350642	0895550	278	99	105	6	99	105	6	--	--	--	6
Sh:K-143	350233	0895938	281	59	112	53	80	112	32	--	--	--	32
Sh:K-148	350228	0895232	300	35	51	16	35	51	16	--	--	--	16
Sh:L-9	350504	0894828	370	45	127	82	45	73	28	100	127	27	55
Sh:L-15	350412	0894530	341	28	74	48	26	74	48	--	--	--	48
Sh:L-17	350721	0895130	310	20	108	88	20	45	25	60	76	16	
							91	108	17	--	--	--	58
Sh:L-18	350516	0894940	320	17	93	76	17	93	76	--	--	--	76
Sh:L-21	350540	0895211	330	51	151	100	99	151	52	--	--	--	52
Sh:L-23	350519	0895212	330	76	155	79	94	155	61	--	--	--	61
Sh:L-25	350435	0895034	288	24	128	104	38	128	90	--	--	--	90
Sh:L-26	350249	0895123	352	43	91	48	43	91	48	--	--	--	48
Sh:L-27	350457	0895044	317	45	154	109	70	154	84	--	--	--	84
Sh:L-29	350440	0894947	325	27	135	108	27	135	108	--	--	--	108
Sh:L-32	350146	0895200	332	23	86	63	23	86	63	--	--	--	63
Sh:L-38	350232	0895158	315	16	72	56	16	72	56	--	--	--	56
Sh:L-46	350858	0894920	280	42	113	71	42	113	71	--	--	--	71
Sh:L-52	350024	0894722	390	52	120	68	52	120	68	--	--	--	68
Sh:L-57	350534	0895121	320	44	157	113	48	157	109	--	--	--	109
Sh:L-61	350354	0895038	272	26	75	49	26	75	49	--	--	--	49
Sh:L-64	350639	0895225	305	53	165	112	88	165	77	--	--	--	77
Sh:L-67	350447	0894826	380	36	136	100	75	85	10	96	136	40	50
Sh:L-69	350259	0895213	329	33	78	45	33	78	45	--	--	--	45
Sh:L-70	350207	0895224	307	21	71	50	20	71	50	--	--	--	50
Sh:L-81	350450	0894807	380	52	156	104	52	82	30	94	156	62	92
Sh:L-88	350730	0894900	257	42	42	0	--	--	--	--	--	--	0
Sh:L-95	350349	0894501	369	58	114	56	58	114	56	--	--	--	56
Sh:L-96	350323	0895156	331	38	90	52	38	90	52	--	--	--	52
Sh:L-97	350207	0895110	353	26	82	56	26	82	56	--	--	--	56
Sh:L-99	350441	0894809	368	32	142	110	32	42	10	44	85	41	
							99	142	43	--	--	--	94
Sh:L-102	350135	0895137	342	90	105	15	90	105	15	--	--	--	15
Sh:M-11	350223	0894459	338	60	71	11	60	71	11	--	--	--	11
Sh:M-17	350017	0894417	336	41	41	0	--	--	--	--	--	--	0
Sh:M-24	350853	0894215	340	33	87	54	33	87	54	--	--	--	54
Sh:M-26	350404	0894356	332	49	66	17	49	66	17	--	--	--	17

Table 2.--*Thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet in the Memphis area*--Continued

Well No.	Lati-tude	Longi-tude	Alti-tude	Base of water-table aquifer	Base of Cook Mountain Formation	Thickness of confining unit	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Aggregate thicknesses of clay beds
Sh:M-27	350334	0894335	355	54	75	21	62	75	13	--	--	--	13
Sh:M-37	350842	0894300	335	42	72	30	42	72	30	--	--	--	30
Sh:M-39	350344	0894449	363	62	98	36	62	98	36	--	--	--	36
Sh:M-40	350480	0894444	342	34	97	63	34	97	63	--	--	--	63
Sh:M-41	350407	0894437	355	64	126	62	64	126	62	--	--	--	62
Sh:M-43	350413	0894133	320	64	64	0	--	--	--	--	--	--	0
Sh:O-1	351437	0900046	229	57	290	233	150	290	140	--	--	--	140
Sh:O-18	351034	0900243	235	76	240	164	76	98	22	118	240	122	144
Sh:O-54	351119	0900223	238	77	306	229	77	185	108	203	306	103	211
Sh:O-87	350828	0900214	266	91	264	173	91	126	35	150	264	114	149
Sh:O-82	350833	0900147	288	87	258	171	87	102	15	164	196	32	
							220	258	38	--	--	--	85
Sh:O-93	350839	0900239	238	46	242	196	46	114	68	129	242	113	181
Sh:O-118	351219	0900232	272	60	328	268	123	328	205	--	--	--	205
Sh:O-120	351050	0900035	230	72	158	86	89	113	24	124	158	34	58
Sh:O-184	350956	0900139	251	78	333	255	78	184	106	193	333	140	246
Sh:O-191	350818	0900335	278	99	292	193	100	148	48	158	292	134	182
Sh:O-194	350817	0900043	285	64	278	214	184	278	94	--	--	--	94
Sh:O-199	350848	0900311	285	65	289	224	102	184	82	179	289	110	172
Sh:O-202	351032	0900143	242	71	256	185	71	256	185	--	--	--	185
Sh:O-204	350922	0900154	257	78	301	223	78	140	62	176	301	125	187
Sh:O-208	350805	0900204	272	82	264	182	82	110	28	166	264	98	126
Sh:O-207	350913	0900109	255	81	236	155	130	236	106	--	--	--	106
Sh:O-213	350918	0900030	250	78	246	168	160	246	86	--	--	--	86
Sh:O-243	350808	0900022	280	70	254	184	70	90	20	166	254	88	108
Sh:P-1	351320	0895401	300	41	239	198	103	120	17	149	239	90	107
Sh:P-11	351028	0893050	244	62	182	120	62	88	26	101	182	81	107
Sh:P-14	350943	0895787	262	62	194	132	62	94	32	107	194	87	119
Sh:P-34	350807	0895825	283	104	188	84	125	188	63	--	--	--	63
Sh:P-36	350950	0895833	243	80	217	137	120	217	97	--	--	--	97
Sh:P-39	351045	0895655	251	62	270	208	62	75	13	83	95	12	
							193	270	77	--	--	--	102
Sh:P-54	350904	0895805	255	80	234	154	166	234	68	--	--	--	68
Sh:P-62	350735	0895733	280	94	170	76	94	106	12	127	170	43	55
Sh:P-69	351220	0895525	300	64	200	136	80	104	24	111	123	12	
							132	200	68	--	--	--	104
Sh:P-71	351323	0895764	290	65	289	224	99	134	35	144	289	145	180
Sh:P-73	350901	0895248	250	52	102	50	52	102	50	--	--	--	50
Sh:P-75	351248	0895525	330	41	276	235	139	276	137	--	--	--	137
Sh:P-78	350735	0895932	267	84	176	92	84	124	40	132	176	44	84
Sh:P-79	350736	0895635	311	109	131	22	109	131	22	--	--	--	22
Sh:P-85	351101	0895240	293	76	220	144	76	117	41	168	220	52	93
Sh:P-86	351131	0895312	275	30	226	196	123	226	103	--	--	--	103

Table 2.--*Thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet in the Memphis area*--Continued

Well No.	Lati-tude	Longi-tude	Alti-tude	Base of water-table aquifer	Base of Cook Mountain Formation	Thickness of confining unit	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Aggregate thicknesses of clay beds
Sh:P-93	350831	0895656	279	88	191	103	88	105	17	181	191	10	27
Sh:P-94	350913	0895739	248	78	171	93	98	171	73	--	--	--	73
Sh:P-98	351435	0895300	312	67	266	199	106	122	16	174	266	92	108
Sh:P-103	350927	0895950	258	86	246	160	152	246	94	--	--	--	94
Sh:P-113	351439	0895722	301	72	287	215	116	138	22	166	287	121	143
Sh:P-114	351449	0895641	232	48	209	161	101	209	108	--	--	--	108
Sh:P-115	351327	0895658	282	43	268	225	43	80	37	142	268	126	163
Sh:P-116	351411	0895748	290	51	270	219	140	160	20	204	270	66	86
Sh:P-117	351409	0895709	245	38	205	167	112	205	93	--	--	--	93
Sh:P-118	351458	0895747	285	58	294	236	166	294	128	--	--	--	128
Sh:P-145	351058	0895739	229	50	258	208	68	88	20	192	258	66	86
Sh:Q-1	350900	0894822	330	66	103	37	66	103	37	--	--	--	37
Sh:Q-7	350940	0894504	313	40	101	61	40	101	61	--	--	--	61
Sh:Q-8	350901	0895113	270	32	144	112	80	144	64	--	--	--	64
Sh:Q-16	350909	0895163	260	48	121	73	48	121	73	--	--	--	73
Sh:Q-21	351215	0895127	295	90	210	120	107	210	103	--	--	--	103
Sh:Q-22	351144	0895044	305	81	136	55	81	136	55	--	--	--	55
Sh:Q-23	351138	0895207	283	66	186	120	86	186	100	--	--	--	100
Sh:Q-24	351315	0895150	281	27	205	178	123	205	82	--	--	--	82
Sh:Q-27	351216	0895103	288	65	166	101	65	166	101	--	--	--	101
Sh:Q-30	351113	0895145	295	78	185	107	78	91	13	140	185	45	58
Sh:Q-34	351055	0895206	273	93	171	78	154	171	17	--	--	--	17
Sh:Q-39	351128	0895130	309	81	152	71	81	95	14	120	152	32	46
Sh:Q-42	351127	0895105	309	78	145	67	120	145	25	--	--	--	25
Sh:Q-66	351155	0895142	281	49	130	81	82	130	48	--	--	--	48
Sh:Q-74	351223	0895221	295	82	154	72	97	108	11	112	154	42	53
Sh:Q-82	351326	0895046	322	60	163	103	85	102	17	142	163	21	38
Sh:Q-88	350733	0894825	262	41	118	77	50	118	68	--	--	--	68
Sh:Q-89	350737	0894856	259	31	49	18	31	49	18	--	--	--	18
Sh:Q-90	350749	0895058	247	54	58	4	54	58	4	--	--	--	4
Sh:Q-124	350822	0895003	273	33	60	27	33	60	27	--	--	--	27
Sh:Q-125	350817	0895035	250	37	66	29	37	66	29	--	--	--	29
Sh:Q-130	350835	0894994	320	56	81	25	56	81	25	--	--	--	25
Sh:R-5	351350	0894425	395	35	252	217	54	78	24	128	152	28	
							171	252	81	--	--	--	131
Sh:R-8	351141	0894411	372	34	174	140	68	80	12	86	106	20	
							142	174	32	--	--	--	64
Sh:R-9	351246	0894053	375	40	121	81	57	121	64	--	--	--	64
Sh:R-10	350841	0893940	375	56	56	0	--	--	--	--	--	--	0
Sh:R-15	351239	0893943	342	28	112	86	54	112	58	--	--	--	58
Sh:R-21	350913	0894338	305	46	59	13	46	59	13	--	--	--	13
Sh:R-22	350843	0894240	370	42	98	56	42	98	56	--	--	--	56

Table 2.–*Thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet in the Memphis area*–Continued

Well No.	Lati-tude	Longi-tude	Alti-tude	Base of water-table aquifer	Base of Cook Mountain Formation	Thickness of confining unit	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Aggregate thicknesses of clay beds
Sh:R-23	350848	0894355	340	48	114	66	48	114	66	--	--	--	66
Sh:R-24	350811	0894244	330	45	110	65	45	110	65	--	--	--	65
Sh:R-25	350737	0894342	278	31	78	47	31	78	47	--	--	--	47
Sh:R-26	351402	0893935	285	31	92	61	31	92	61	--	--	--	61
Sh:R-28	350848	0894318	360	34	87	53	34	84	53	--	--	--	53
Sh:R-29	350835	0894341	315	48	107	59	48	107	59	--	--	--	59
Sh:R-30	350811	0894309	325	40	120	80	80	120	40	--	--	--	40
Sh:T-6	351805	0900322	290	165	326	161	296	326	30	--	--	--	30
Sh:T-7	352040	0900154	400	99	420	321	99	120	21	136	206	70	
							209	219	10	286	296	10	
							328	420	92	--	--	--	203
Sh:T-13	352213	0900058	400	90	454	364	123	166	43	228	262	34	
							367	454	87	--	--	--	164
Sh:T-16	352044	0900249	355	102	398	296	112	150	38	321	337	16	
							344	398	54	--	--	--	108
Sh:T-17	351747	0900329	330	92	448	356	110	159	49	182	243	61	
							305	323	18	385	448	63	191
Sh:T-18	352127	0900107	391	75	450	375	120	148	28	366	450	84	112
Sh:U-1	352113	0895706	284	68	216	148	154	216	62	--	--	--	62
Sh:U-8	352057	0895727	288	79	232	153	172	232	60	--	--	--	60
Sh:U-12	351705	0895320	238	92	180	88	92	180	88	--	--	--	88
Sh:U-19	351603	0895640	242	73	207	134	105	118	13	130	207	77	90
Sh:U-22	351737	0895748	300	60	226	166	98	109	11	124	166	42	
							171	226	55	--	--	--	108
Sh:U-29	351558	0895859	242	71	194	123	109	194	85	--	--	--	85
Sh:U-48	352114	0895727	287	74	152	78	80	152	72	--	--	--	72
Sh:U-49	352023	0895827	251	50	155	105	82	155	73	--	--	--	73
Sh:U-52	352030	0895708	257	54	198	144	102	114	12	124	158	34	
							174	198	24	--	--	--	70
Sh:U-54	352034	0895345	265	74	212	138	74	94	20	152	166	14	
							192	212	20	--	--	--	54
Sh:U-55	352036	0895334	285	96	216	120	137	150	13	166	182	16	
							204	216	12	--	--	--	41
Sh:U-56	351907	0895709	282	60	230	170	178	230	52	--	--	--	52
Sh:U-58	352024	0895257	265	66	174	108	66	174	108	--	--	--	108
Sh:U-59	352009	0895253	265	97	164	67	97	164	67	--	--	--	67
Sh:U-60	352027	0895232	292	88	204	116	148	204	56	--	--	--	56
Sh:V-4	352044	0895219	283	78	205	127	78	110	32	160	205	45	77
Sh:V-7	351544	0894618	278	27	177	150	27	72	45	124	177	53	98
Sh:V-9	352012	0895038	273	60	222	162	150	222	72	--	--	--	72
Sh:V-10	352010	0895036	271	63	185	122	116	144	28	150	185	35	63
Sh:V-16	351904	0894900	283	61	164	103	94	134	40	--	--	--	40
Sh:V-17	351850	0894935	282	63	180	117	120	180	60	--	--	--	60
Sh:V-24	352227	0895043	375	69	362	293	255	362	107	--	--	--	107

Table 2.--*Thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet in the Memphis area*--Concluded

Well No.	Lati-tude	Longi-tude	Alti-tude	Base of water-table aquifer	Base of Cook Mountain Formation	Thickness of confining unit	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Clay bed top	Clay bed bot-tom	Clay bed thick-ness	Aggregate thicknesses of clay beds
Sh:W-3	351750	0893943	279	49	66	17	49	66	17	--	--	--	17
Sh:W-7	352026	0894408	322	31	202	171	31	44	13	49	60	11	
							102	202	100	--	--	--	124
Sh:W-13	351938	0894130	320	42	147	105	84	147	63	--	--	--	63
Sh:W-16	351923	0894228	364	44	216	172	44	113	69	124	216	92	161
Tp:E-3	352641	0894721	441	102	411	309	160	194	34	338	411	73	107
Tp:F-3	352517	0894124	405	55	296	241	210	296	86	--	--	--	86

Geophysical logs were chosen as the primary source of information about the confining unit. The logs can be interpreted and correlated based on recorded measurements of the electrical characteristics (electric logs) of the sediments and contained water, and the natural radioactivity (gamma-ray logs) of the sediments. Descriptive driller's and geologist's logs, when available, were used to supplement the geophysical logs. These logs were particularly useful in determining the base of the water-table aquifers in wells where geophysical logs were not made in the upper parts of the bore holes that included the contact with the underlying Jackson-upper Claiborne confining unit. During the drilling of some wells, the near surface formations were cased off to prevent caving before drilling was continued to total depth.

Driller's and geologist's logs of test holes for water wells drilled by hydraulic rotary methods, when used alone, generally were not considered to be satisfactory for determining the thickness of the confining unit or estimating the thickness of clay beds within the confining unit. The sand and gravel of the water-table aquifers commonly cave into the bore hole and obscure recognition of the top of the Jackson-upper Claiborne confining unit. Because of caving, some driller's and geologist's logs indicate the occurrence of gravel to unreasonable depths. In addition, sand in the upper part of the confining unit commonly is included with the sand and gravel of the alluvium and fluvial deposits. This gives an exaggerated impression of the thickness of these units. The local occurrence of clay and interbedded clay and fine sand in the upper part of the Memphis Sand obscures determination of the base of the confining unit. In addition, very fine or silty fine sand in the upper part of the Memphis Sand commonly is logged as "clay" or "sandy clay."

Sediments encountered in a bore hole and described in driller's logs often are identified by drill penetration rate, drill action, and sample material recovered from the drilling mud returns. This precludes any further interpretation or correlation of the logs based on visual inspection, as is possible using geophysical logs. In the Memphis area, driller's logs of test holes drilled for water wells are made primarily to record thickness and grain size of the sands that have potential for installing water wells. The logs also record the thickness of sediments that may cause caving or penetration problems while drilling a water well, such as thick intervals of sand and gravel or clay. Consequently, intervals of fine sand, silt, and clay are logged in general terms, such as "sand and clay mixed," "clay with streaks of sand," or "clay." Very fine sand and silt commonly pass through in the drilling mud unnoticed and are difficult to collect and examine unless a special effort is made.

Geophysical logs also have some limitations. The more than 500 geophysical logs in the USGS files were made during a period of about 35 years. Modifications in the instrumentation were made several times, and the geophysical logs were made by many individuals with varying degrees of experience. As a result of problems with the logging equipment and bore-hole conditions, the logs vary greatly in quality. One problem that affects the quality of electric logs are local "stray" electrical currents near high-voltage lines or utility power substations. Factors affecting gamma-ray logs, not easily recognizable, are possible shielding of the logger tool by cement grout and casing in large diameter wells. This may result in clay being recorded with a log trace that might be interpreted as sand. Also, the possible presence of radioactive mineral grains (for example, monazite) may result in some sands being recorded with a log trace that might be interpreted as clay.

The map in this report (plate 1) showing the thickness of the Jackson-upper Claiborne confining unit and aggregate thicknesses of clay beds in the confining unit thicker than 10 feet differs significantly from the small scale maps in a previous report by Graham and Parks (1986, fig. 3 and 4). The thickness of the confining unit on plate 1 is shown as much as 150 feet thinner in some areas, and consequently, not as much clay is included in the confining unit in these areas. This difference is the result of new data from many additional geophysical logs made since the previous investigation, a refinement in the definition of the lower boundary of the Jackson-upper Claiborne confining unit, and a re-correlation of the geophysical logs in the USGS files.

For the previous investigation by Graham and Parks (1986), the Jackson-upper Claiborne confining unit was considered to be that interval of sediments between the base of the water-table aquifers and the top of the first prominent sand in the Memphis aquifer. This definition of the lower boundary of the confining unit included thick local intervals of clay or interbedded clay and fine sand in the upper part of the Memphis Sand. These thick intervals of clay or interbedded clay and fine sand are highly variable and may interfinger with sand in the main body of the Memphis aquifer within short lateral distances.

For the present investigation, the Jackson-upper Claiborne confining unit was redefined to be that interval of sediments between the base of the water-table aquifers and the base of the Cook Mountain Formation (top of the Memphis Sand). The base of the Cook Mountain Formation commonly is very difficult to recognize, particularly where it overlies a thick interval of clay or interbedded clay and fine sand in the upper part of the Memphis Sand. However, a determined effort was made to identify this contact. Possible positions of this contact on the geophysical logs were compared as related to an altitude where this contact locally would be expected assuming a relatively low, "normal" (as opposed to extreme) dip of the base of the formation toward the axis of the Mississippi embayment (approximately the Mississippi River). In addition, consideration was given to the expected local thickness of the underlying Memphis Sand (where geophysical logs are available to provide information to this depth), a range in thickness to be expected for the Cook Mountain Formation, and tentative identification of the overlying Cockfield Formation.

The GC-RASA work indicated that many faults exist in the Memphis area that displace the bases of the Cockfield Formation, Memphis Sand, and the Fort Pillow Sand (Parks and Carmichael, 1989; 1990a,b). During the present investigation, while comparing the expected altitude of the base of the Cook Mountain Formation between individual wells and among groups of wells, displacements in this contact between some areas indicated that many other faults may exist. Vertically, these displacements seemed to be less than 50 to 100 feet, which is comparable to the displacements of the faults identified during the GC-RASA investigation.

Water Table in the Alluvium and Fluvial Deposits

The altitude of the water table in the alluvium and fluvial deposits in the Memphis area is shown in plate 2. This map was prepared using: (1) water levels measured in 60 wells in the fall 1988; (2) water levels from historic records (1944-87) of 39 wells in the USGS files; (3) a composite reduction of 15-minute topographic quadrangles to overlay for topographic control; and (4) altitudes of water levels in the larger perennial streams based on USGS 7 1/2-minute topographic quadrangles published during 1965-71 (only 20-foot-contour-interval data was used). Most water-level data are from wells screened in the alluvium or fluvial deposits. However, several wells were screened in sand in the Cockfield Formation just below the fluvial deposits where the Cockfield and fluvial deposits are in direct hydraulic connection. Water-level data from wells used to prepare the water-table map are given in tables 3 and 4.

Table 4.--*Water levels from records of wells screened in the water-table aquifers in the Memphis area, 1944-87*

[Latitude and longitude are in degrees, minutes and seconds; USGS local aquifer designations are 111ALVM for the alluvium, 112TRRC for the fluvial deposits (terrace deposits), and 124CCKF for the Cockfield Formation; less than (<) indicates that in wells that were dry the altitude of the water level is below the altitude of the bottom of the well]

Well No.	Latitude	Longitude	Altitude of land-surface datum, in feet above sea level	Well depth, in feet	Aquifer	Water level below land-surface datum		Water-level altitude, in feet above sea level
						Depth, in feet	Date of measurement	
Ar:O-4	350744	0900558	227	130	111ALVM	44	1976	183
Ar:O-5	351349	0900628	217	61	111ALVM	19	1984	198
Ms:A-8	345741	0900717	290	100	124CCKF	52	1971	238
Ms:A-14	345930	0901331	209	115	111ALVM	17	1971	192
Ms:A-55	345710	0900940	209	32	111ALVM	14	1980	195
Ms:A-58	345753	0901152	213	112	111ALVM	23	1981	190
Ms:A-104	345827	0900844	213	118	111ALVM	18	1970	195
Ms:B-54	345940	0900131	275	63	112TRRC	16	1973	259
Ms:B-59	345810	0900527	305	105	124CCKF	46	1972	259
Sh:H-12	350152	0901046	213	58	111ALVM	13	1964	200
Sh:J-7	350053	0900133	309	81	112TRRC	43	1958	266
Sh:J-149	350512	0900710	245	111	111ALVM	50	1969	195
Sh:J-150	350029	0900345	300	81	112TRRC	48	1969	252
Sh:J-155	350203	0900349	285	62	112TRRC	28	1966	257
Sh:J-162	350310	0900341	280	90	112TRRC	30	1984	250
Sh:J-182	350022	0900112	295	70	112TRRC	35	1969	260
Sh:K-95	350817	0895526	310	94	112TRRC	dry	1965	<216
Sh:K-108	350023	0895840	325	43	112CCKF	10	1987	315
Sh:K-134	350023	0895738	375	88	112TRRC	39	1984	336
Sh:L-94	350228	0895122	352	67	112TRRC	dry	1966	<285
Sh:O-192	351248	0900330	221	80	111ALVM	30	1984	191
Sh:O-215	351040	0900255	248	100	111ALVM	55	1971	193
Sh:O-236	351417	0900327	283	107	112TRRC	23	1984	260
Sh:P-33	350807	0895824	295	87	112TRRC	47	1944	248
Sh:P-105	351310	0895753	300	82	112TRRC	35	1966	265
Sh:Q-54	351221	0895221	295	82	112TRRC	43	1984	252
Sh:Q-79	351124	0895200	291	70	112TRRC	50	1968	241
Sh:Q-85	351130	0894734	320	80	112TRRC	36	1984	284
Sh:Q-93	351454	0895146	290	62	112TRRC	17	1966	273
Sh:Q-128	350817	0895035	250	39	111ALVM	34	1987	216

Table 4.--*Water levels from records of wells screened in the water-table aquifers in the Memphis area, 1944-87*--Concluded

Well No.	Latitude	Longitude	Altitude of land-surface datum, in feet above sea level	Well depth, in feet	Aquifer	Water level below land-surface datum: Depth, in feet	Water level below land-surface datum: Date of measurement	Water-level altitude, in feet above sea level
Sh:R-17	351340	0894334	380	50	112TRRC	40	1987	340
Sh:R-27	350854	0894320	330	39	112TRRC	dry	1987	<291
Sh:U-33	352050	0895453	275	80	112TRRC	45	1970	230
Sh:U-34	351758	0895803	300	85	112TRRC	35	1970	265
Sh:U-40	352008	0895707	245	60	111ALVM	28	1981	217
Sh:U-43	351958	0895932	301	83	112TRRC	43	1984	258
Sh:V-13	351737	0894930	305	70	112TRRC	30	1970	275
Sh:V-14	352124	0894848	320	88	112TRRC	20	1970	300
Sh:V-18	351945	0894534	318	72	112TRRC	30	1970	288

Table 3.--*Water levels measured in wells screened in the water-table aquifers in the Memphis area, fall 1988*

[Latitude and longitude are in degrees, minutes, and seconds; USGS local aquifer designations are 111ALVM for the alluvium, 112TRRC for the fluvial deposits (terrace deposits), and 124CCKF for the Cockfield Formation]

Well No.	Latitude	Longitude	Altitude of land-surface datum, in feet above sea level	Well depth, in feet	Aquifer	Water level below land-surface datum: Depth, in feet	Water level below land-surface datum: Date of measurement	Water-level altitude, in feet above sea level
Ar:H-3	350344	0901300	211	63	111ALVM	25.67	11-08-88	185
Fa:R-10	352130	0893614	395	39	112TRRC	31.30	10-19-88	364
Sh:J-162	350302	0900412	216	29	111ALVM	16.08	10-17-88	200
Sh:J-163	350255	0900411	280	69	112TRRC	33.76	10-17-88	246
Sh:J-164	350107	0900838	270	66	112TRRC	32.01	10-17-88	238
Sh:J-171	350508	0900150	232	71	112TRRC	24.77	10-25-88	207
Sh:J-172	350124	0900722	292	110	112TRRC	53.05	10-26-88	239
Sh:J-173	350554	0900222	295	112	112TRRC	59.30	10-20-88	236
Sh:J-174	350510	0900200	247	44	112TRRC	40.80	10-20-88	206
Sh:J-175	350359	0900148	226	26	111ALVM	13.48	10-18-88	213
Sh:J-176	350343	0900123	238	36	111ALVM	23.10	10-21-88	215
Sh:J-177	350512	0900454	241	53	112TRRC	29.15	10-18-88	212
Sh:J-178	350505	0900523	223	40	111ALVM	39.16	10-18-88	184
Sh:J-179	350728	0900317	274	43	112TRRC	15.57	10-21-88	258
Sh:K-75	350514	0895537	257	91	124CCKF	51.05	10-25-88	206
Sh:K-123	350107	0895747	342	38	124CCKF	23.87	10-17-88	318
Sh:K-129	350024	0895715	380	94	124CCKF	63.77	10-17-88	316
Sh:K-137	350704	0895555	293	86	112TRRC	81.60	10-25-88	211
Sh:K-144	350308	0895811	266	53	112TRRC	48.10	10-18-88	218
Sh:K-145	350416	0895847	260	38	112TRRC	31.35	10-18-88	229
Sh:K-146	350028	0895807	365	59	112TRRC	47.71	10-17-88	317
Sh:K-147	350427	0895241	273	30	112TRRC	20.42	10-20-88	253
Sh:L-66	350021	0895051	349	20	112TRRC	13.26	10-17-88	336
Sh:O-236	351058	0900050	217	31	111ALVM	14.55	10-17-88	202
Sh:O-244	350918	0900148	252	93	112TRRC	18.72	10-26-88	233
Sh:O-245	350915	0900052	242	80	112TRRC	8.30	10-26-88	234
Sh:O-246	350617	0900229	258	56	112TRRC	13.50	10-18-88	244
Sh:O-247	351225	0900159	271	39	112TRRC	38.00	10-19-88	233
Sh:O-248	351240	0900306	236	57	112TRRC	37.41	10-19-88	199
Sh:P-99	350858	0895914	271	59	112TRRC	38.30	10-26-88	233

Table 3.–*Water levels measured in wells screened in the water-table aquifers in the Memphis area, fall 1988*–Concluded

Well No.	Latitude	Longitude	Altitude of land-surface datum, in feet above sea level	Well depth, in feet	Aquifer	Water level below land-surface datum: Depth, in feet	Water level below land-surface datum: Date of measurement	Water-level altitude, in feet above sea level
Sh:P-107	351437	0895551	295	82	112TRRC	30.78	10-20-88	264
Sh:P-123	351115	0895633	220	29	111ALVM	13.78	10-19-88	206
Sh:P-144	351040	0895828	245	74	112TRRC	25.82	10-19-88	219
Sh:P-146	351318	0895256	321	58	112TRRC	21.25	10-20-88	300
Sh:P-197	351430	0895732	301	80	112TRRC	57.54	10-25-88	243
Sh:P-198	350945	0895647	263	40	112TRRC	29.20	10-20-88	234
Sh:P-199	351317	0895434	320	40	112TRRC	31.11	10-20-88	289
Sh:P-200	350916	0895808	260	45	112TRRC	29.86	10-19-88	230
Sh:Q-87	350812	0894700	330	80	112TRRC	23.85	10-19-88	306
Sh:Q-88	351120	0895057	299	70	112TRRC	59.74	10-20-88	239
Sh:Q-94	351111	0895125	310	90	112TRRC	70.72	10-26-88	239
Sh:Q-95	350749	0895058	247	36	111ALVM	15.23	10-24-88	232
Sh:Q-98	350739	0895017	254	52	111ALVM	35.83	10-24-88	218
Sh:Q-101	350741	0894909	258	38	111ALVM	35.64	10-24-88	222
Sh:Q-107	350844	0895032	264	44	111ALVM	26.28	10-25-88	238
Sh:Q-114	350753	0894933	260	45	111ALVM	44.86	10-25-88	215
Sh:Q-118	350853	0895140	246	28	111ALVM	17.06	10-26-88	229
Sh:Q-131	351406	0895167	328	59	112TRRC	23.65	10-20-88	304
Sh:T-21	351928	0900136	362	85	112TRRC	50.71	10-20-88	311
Sh:T-22	352132	0900112	401	120	112TRRC	87.86	10-20-88	313
Sh:U-39	352018	0895652	246	53	111ALVM	27.28	10-20-88	218
Sh:U-61	351856	0895507	300	68	112TRRC	27.40	10-19-88	273
Sh:U-62	352045	0895713	261	22	112TRRC	14.25	10-19-88	247
Sh:U-63	351907	0895631	257	38	112TRRC	9.45	10-19-88	248
Sh:U-64	351905	0895707	280	51	112TRRC	32.40	10-19-88	248
Sh:W-20	351702	0894033	281	30	112TRRC	7.48	10-19-88	274
Sh:W-21	351857	0893858	379	38	112TRRC	37.20	10-19-88	342
Sh:W-22	351715	0893857	318	20	112TRRC	10.95	10-19-88	307
Tp:D-3	352524	0895848	430	102	112TRRC	72.12	10-21-88	358
Tp:F-10	352539	0894018	335	20	112TRRC	15.72	10-21-88	319

For the fall 1988, when much of the data were collected, the map (plate 2) probably is accurate to one-half a contour interval (10 feet) where control is abundant and the land surface is not too irregular. In other areas where control is sparse and the land surface is irregular, the map may be accurate to one contour interval (20 feet), depending on the degree of local irregularity and relief. In areas of sparse control, as yet unidentified areas may exist where the water table is depressed because of downward leakage from the water-table aquifers to the Memphis aquifer. In any such areas, of course, the above estimates of map accuracy do not apply. Water levels in the water-table aquifers generally are high in the winter and spring and low in the summer and fall. Therefore, the water-table map (plate 2) is considered to represent low water-level conditions during 1988. Water levels in water-table aquifers fluctuate seasonally at varying rates from place to place.

Long-term records are available for only a few observation wells in the water-table aquifers. Well Sh:P-99 (plate 2), located in a wooded area of Overton Park about 1 mile east of the Mallory well field, is screened in the fluvial deposits. Water levels in this well do not seem to be affected by downward leakage from the water-table aquifers to the Memphis aquifer as indicated by a correlation of changes in water levels with variations in annual precipitation (Graham, 1982). Water-levels in Sh:P-99 fluctuate from about 1 to 8 feet each year. Well Sh:K-75 (plate 2), located in the southern part of the Sheahan well field, is screened in sand in the upper part of the Cockfield Formation just below the base of the fluvial deposits. The water level in this well is affected by leakage from the water-table aquifers to the Memphis aquifer and has declined about 22 feet in 34 years (1951-85) (Graham and Parks, 1986). The early part of the record for this well (1948-50), before pumping was begun from the Memphis aquifer in this area, shows seasonal fluctuations of about 5 feet each year. Later record (1977-85) shows that seasonal fluctuations are less than "normal" at about 1 to 3 feet each year.

During 1986 and 1987, nine wells were installed in the fluvial deposits in the MLGW well fields (McMaster and Parks, 1988). Monthly water-level measurements in seven of these wells (two were dry) indicate seasonal fluctuations ranging from less than 0.5 foot in well Sh:Q-94 at the McCord well field to about 5 feet in well Sh:J-172 in the Davis well field (plate 2). Well Sh:Q-94 is in or on the margin of a depression in the water table associated with downward leakage in the McCord well field area. Fluctuations in the water table greater than 10 feet within a year probably occur in the alluvium adjacent to the Mississippi River and major tributaries in the Memphis area where water levels are affected by variations in the stages of these rivers.

The mapped area of the water table is not extended into the southeastern and eastern parts of the Memphis area where the Jackson-upper Claiborne confining unit is absent because of a general lack of control. In this area, the water table is in the alluvium beneath the alluvial plains and in the fluvial deposits or the Memphis aquifer beneath the hills, ridges, and valley slopes.

West of the approximate eastern limits of the Jackson-upper Claiborne confining unit occurs a belt of disconnected areas designated "NSST" on the water-table map (plate 2). The phrase "no significant saturated thickness" (NSST), as used in this report, implies that the fluvial deposits are dry or are saturated for only a few inches or feet in the basal part. Mapping of the "NSST" areas is based on (1) a lack of historic records of shallow wells in these areas in the files of the USGS and the TDHE, (2) unsuccessful searches for shallow wells in which to measure water levels or to collect samples for water-quality analyses for this and previous investigations (Graham and Parks, 1986;

McMaster and Parks, 1988), and (3) a few wells installed in the fluvial deposits that were essentially dry (McMaster and Parks, 1988). Upon consideration of the large extent of some of these areas, it is evident that significant refinements can be made to the boundaries.

Because the water-table aquifers generally are unconfined, the configuration of the water table is complex (plate 2). The water table is lower than the land surface (except at springs and seeps), but it generally conforms to the topography. Beneath the hills and ridges, the water table is at higher altitudes and greater depths; whereas beneath the valleys and alluvial plains, it is at lower altitudes and lesser depths. In areas of moderate to high relief, local perched water tables above clay or silt beds in the loess or fluvial deposits add to the complexity of determining the configuration of the principal water-table surface. These perched water tables are higher than the principal water-table surface, commonly occur as only a few feet of saturated material, and probably occur in "pockets" that are not very extensive.

Along and for a few miles east of the bluffs, water in the fluvial deposits locally is confined beneath the loess, and water levels in tightly cased wells rise above the top of the fluvial deposits. During the winter and spring when the Mississippi River is at high or flood stages, water in the alluvium locally is confined beneath fine sediments in the upper part, and water levels in tightly cased wells rise above the top of the lower sand and gravel to near or above land surface.

Recharge to the water-table aquifers is primarily from downward infiltration of precipitation that falls on the land surface and is greatest in the winter and spring months when precipitation is greatest. In the summer and fall months, water levels decline in the water-table aquifers because water discharges to perennial streams and maintains base flows. Under natural conditions, the water table is not lower in altitude than low stages or base flows in adjacent streams. However, where leakage is taking place from the water-table aquifers to the Memphis aquifer, depressions in the water table can be as much as 14 feet below the stage of base flow of adjacent streams, such as in an area adjacent to the Wolf River just north of the Shelby County landfill (M.W. Bradley, USGS, written commun., 1989).

Horizontal flow directions in the water-table aquifers at any particular place can be approximated by drawing flow lines perpendicular to the contours on the water-table map (plate 2). Horizontal flow in the water-table aquifers is from the higher water-table altitudes toward the lower altitudes along these lines.

Potentiometric Surface of the Memphis Aquifer

The altitude of the potentiometric surface of the Memphis aquifer is shown in plate 3. This map was prepared using water-level measurements made in 81 observation and production wells screened in the upper or middle parts of the Memphis aquifer. Methods of measurement included steel-tape measurements in observation wells and nonpumping municipal and industrial wells and airline measurements in MLGW wells that were turned off over night to allow for recovery from pumping levels. Data used to prepare the map of potentiometric surface of the Memphis aquifer are given in table 5.

For the late summer and fall 1988, when the data were collected, the map (plate 3) of the potentiometric surface of the Memphis aquifer probably is accurate to one-half a contour interval (5 feet). However, water levels in the Memphis aquifer fluctuate seasonally. In most of the Memphis area, these seasonal fluctuations are more the result of increases or decreases in pumping from the aquifer rather than to the direct effects of recharge. In general, pumping from the Memphis aquifer is less in the winter

Table 5.--*Water levels measured in wells screened in the Memphis aquifer in the Memphis area, late summer and fall 1988*

[Latitude and longitude are in degrees, minutes, and seconds; USGS local aquifer designation is 124MMPS for the Memphis Sand]

Well No.	Latitude	Longitude	Altitude of land-surface datum, in feet above sea level	Well depth, in feet	Water level below land-surface datum: Depth, in feet	Water level below land-surface datum: Date of measurement	Water-level altitude, in feet above sea level
Ar:C-1	350958	0901738	209	622	25.24	09-16-88	184
Ar:H-2	350344	0901300	211	500	31.70	09-16-88	179
Ar:O-1	351349	0900628	217	497	41.63	09-16-88	175
Ms:B-9	345709	0900205	301	392	99.98	11-16-88	201
Ms:D-58	345820	0895142	390	220	150.35	11-16-88	240
Fa:R-2	352226	0893301	317	365	41.75	10-04-88	275
Sh:H-1	350331	0900729	312	348	143.73	09-13-88	168
Sh:H-8	350157	0900742	305	622	137.10	09-13-88	168
Sh:J-1	350004	0900546	240	334	63.66	09-16-88	176
Sh:J-4	350524	0900458	285	302	132.40	09-13-88	153
Sh:J-28	350639	0900436	288	306	137.13	09-13-88	151
Sh:J-37	350707	0900122	305	510	179.82	09-13-88	125
Sh:J-52	350408	0900415	241	498	92.66	09-13-88	148
Sh:J-70	350201	0900212	298	581	127.72	11-08-88	170
Sh:J-74	350022	0900117	303	398	118.26	11-08-88	185
Sh:J-97	350602	0900210	271	378	147.90	09-13-88	123
Sh:J-110	350507	0900110	253	390	117.90	09-13-88	135
Sh:J-120	350511	0900200	247	452	123.30	09-13-88	124
Sh:J-126	350433	0900151	234	265	98.40	09-13-88	136
Sh:J-139	350100	0900703	291	466	123.20	09-13-88	168
Sh:J-140	350124	0900722	293	553	127.72	10-05-88	165
Sh:J-165	350538	0900631	245	400	85.61	11-08-88	159
Sh:K-14	350539	0895855	292	440	145.22	09-12-88	147
Sh:K-20	350618	0895922	295	220	139.53	09-12-88	155
Sh:K-31	350143	0895357	317	176	113.84	09-12-88	203
Sh:K-66	350724	0895552	303	499	165.70	09-15-88	137
Sh:K-72	350509	0895553	252	292	81.22	09-12-88	171
Sh:K-79	350024	0895827	350	370	155.91	09-12-88	194
Sh:K-122	350434	0895739	240	210	80.94	09-12-88	159
Sh:K-133	350113	0895543	338	210	135.53	09-12-88	202
Sh:K-138	350625	0895549	280	598	128.60	09-15-88	151
Sh:K-140	350653	0895517	297	624	141.50	09-13-88	156
Sh:L-8	350506	0894832	375	305	162.05	09-15-88	213
Sh:L-13	350354	0895218	302	275	109.97	09-12-88	192
Sh:L-15	350412	0894530	341	220	92.24	09-12-88	249
Sh:L-24	350243	0895213	345	427	168.30	09-13-88	177
Sh:L-26	350248	0895123	352	432	166.70	09-13-88	185
Sh:L-39	350206	0895109	346	349	151.95	09-15-88	194
Sh:L-43	350115	0895049	365	185	154.54	09-12-88	210
Sh:L-54	350252	0894503	352	135	92.68	09-12-88	259

Table 5.--*Water levels measured in wells screened in the Memphis aquifer in the Memphis area, late summer and fall 1988*--Concluded

Well No.	Latitude	Longitude	Altitude of land-surface datum, in feet above sea level	Well depth, in feet	Water level below land-surface datum: Depth, in feet	Water level below land-surface datum: Date of measurement	Water-level altitude, in feet above sea level
Sh:L-64	350639	0895225	305	261	108.60	09-12-88	196
Sh:O-1	351437	0900046	229	434	66.75	10-04-88	162
Sh:O-29	350853	0900307	265	442	132.05	09-14-88	133
Sh:O-46	351029	0900149	240	471	107.08	09-13-88	133
Sh:O-115	351219	0900232	272	563	125.56	09-13-88	146
Sh:O-204	350922	0900154	257	471	138.20	09-14-88	119
Sh:O-238	350913	0900104	251	517	134.70	09-14-88	116
Sh:P-1	351320	0895401	300	342	129.12	09-14-88	171
Sh:P-8	351029	0895750	244	428	106.86	09-13-88	137
Sh:P-22	350931	0895758	245	315	106.25	09-14-88	139
Sh:P-37	351025	0895654	252	335	100.98	09-13-88	151
Sh:P-61	350735	0895734	288	361	132.91	09-14-88	155
Sh:P-76	350735	0895932	287	488	144.05	09-14-88	143
Sh:P-85	351101	0895240	293	319	121.82	10-04-88	171
Sh:P-96	351435	0895300	312	456	125.62	09-19-88	186
Sh:P-131	351420	0895706	247	404	106.20	09-14-88	141
Sh:P-134	351440	0895723	301	411	155.60	09-14-88	145
Sh:P-143	351058	0895739	229	442	90.39	09-13-88	139
Sh:P-146	350926	0895949	255	512	130.50	09-14-88	125
Sh:Q-1	350900	0894822	330	384	108.24	09-16-88	222
Sh:Q-60	351224	0895215	285	491	126.73	09-14-88	158
Sh:Q-63	351124	0895143	309	506	140.45	09-14-88	169
Sh:Q-69	351203	0895129	281	477	104.45	09-14-88	177
Sh:Q-71	351045	0895151	302	406	131.40	09-14-88	171
Sh:Q-76	351359	0894829	310	430	86.50	09-14-88	224
Sh:Q-81	351325	0895049	317	509	125.16	09-14-88	192
Sh:Q-84	351347	0894952	325	200	121.80	09-14-88	203
Sh:Q-125	350817	0895035	250	100	41.73	09-19-88	208
Sh:R-5	351350	0894425	395	330	160.89	09-15-88	234
Sh:R-15	351239	0893943	342	150	78.20	09-15-88	264
Sh:R-29	350835	0894341	315	585	72.20	09-13-88	243
Sh:U-2	352113	0895709	269	440	63.41	10-04-88	206
Sh:U-7	352032	0895344	265	411	55.85	09-15-88	209
Sh:U-15	351602	0895829	240	431	96.19	09-19-88	144
Sh:U-22	351737	0895749	300	387	127.97	09-15-88	172
Sh:U-25	351641	0895713	248	430	79.16	09-15-88	169
Sh:V-7	351544	0894616	278	300	43.67	09-15-88	234
Sh:V-8	352012	0895038	273	445	58.45	09-15-88	215
Sh:W-3	351750	0893943	279	221	21.83	09-15-88	257
Sh:W-18	351923	0894228	364	499	116.20	09-15-88	248
Tp:E-12	352445	0894944	337	470	106.83	11-17-88	230

and spring, and water levels rise. Beginning in early summer, the demand for water increases and pumping increases. Pumping continues to increase through the summer, and water levels continue to decline. Low water levels are reached in the late summer or fall. Therefore, the map of the potentiometric surface of the Memphis aquifer (plate 3) is considered to represent low water-level conditions during 1988.

Because of variations in amounts of water pumped in different areas and changes in pumping patterns in and among MLGW well fields, the effect of pumping on water levels varies spatially. The amount of local seasonal fluctuation can only be determined from the records of observation wells at particular places. An indication of the magnitude of water-level fluctuations in the Memphis aquifer is provided by the long-term record of a few principal observation wells in areas away from MLGW well fields. In well Fa:R-2 (plate 3), located in northwestern Fayette County, Tenn., water levels fluctuate about 1 to 1.5 feet each year. In well Sh:Q-1 (plate 3), located in southeastern Shelby County, Tenn., water levels fluctuate about 2 to 3 feet each year. In well Sh:P-76 (plate 3), located in midtown Memphis, water levels fluctuate about 7 to 17 feet each year. In contrast, water levels in Sh:O-179, an observation well located on a MLGW well lot with production well Sh:O-204 (plate 3), fluctuate as much as 45 feet each year. Near the Mississippi River, water levels in wells screened in the Memphis aquifer may rise as a result of loading effects from sustained high stages of the Mississippi River, particularly during winter and spring flood events (Parks and others, 1985).

Outside of the Memphis area where the Memphis aquifer is confined, the potentiometric surface slopes gently westward toward the axis of the Mississippi embayment, and the water moves slowly in that direction (Parks and Carmichael, 1990c). In the Memphis area, a major depression has developed in the potentiometric surface as a result of the long-term (1886-present) pumpin at municipal and industrial well fields. Superim posed on this major depression are localize cones of depression centered at municipal an industrial well fields (plate 3). The velocity c water moving into the major depression is rela tively slow but increases considerably in the prox imity of pumping centers (Bell and Nymar 1968).

In addition to seasonal fluctuations, wate levels in the Memphis aquifer are also affecte by long-term changes. A few principal observa tion wells in areas away from MLGW well fiel also give an indication of the magnitude of thes changes. Well Fa:R-2 (plate 3) is the farthest these wells from the center of the major depre sion in the potentiometric surface at Memphi The water level in Fa:R-2 has declined abo 3 feet in 39 years (1949-88), an average rate less than 0.1 foot per year. Well Sh:Q-1 (plate is at an intermediate distance between Fa:R and the center of the major depression. T water level in Sh:Q-1 has declined about 34 fe in 48 years (1940-88), an average rate of abc 0.7 foot per year. Well Sh:P-76 (plate 3) is ne the center of the major depression. The wa level in Sh:P-76 has declined about 78 feet in years (1928-88), an average rate of about 1.3 f per year.

Recharge to the Memphis aquifer fr precipitation generally occurs along the br outcrop or subcrop belt where it is at or near surface across western Tennessee (Grab 1982). This outcrop or subcrop belt extends i the Memphis area east and southeast of the proximate eastern limits of the Jackson-up Claiborne confining unit (plate 3). In this a the Memphis aquifer generally is unconfined is covered by the alluvium and fluvial depo Therefore, recharge is by downward infiltra of water from precipitation through the alluv and fluvial deposits into the Memphis aquif

Where that aquifer is confined and head differences are favorable, a component of recharge locally enters the Memphis aquifer by downward leakage from the water-table aquifers or the Jackson-upper Claiborne confining unit. Conditions for downward leakage are particularly favorable where the confining unit is thin or absent or where leakage is induced by intense pumping from the Memphis aquifer, as in the vicinity of MLGW well fields (Graham and Parks, 1986). Conditions for downward leakage also may be favorable where the Cook Mountain Formation has been displaced vertically by faults, leaving sands in the Cockfield Formation and the Memphis aquifer in direct hydraulic connection (Parks and others, 1985).

Horizontal flow direction in the Memphis aquifer at any particular place can be approximated by drawing flow lines perpendicular to the potentiometric contours on plate 3. In general, horizontal flow is toward the center of the major depression, which is deepest in the area of the Mallory and Allen well fields. Locally, ground water also flows towards smaller cones of depression at other MLGW and industrial well fields.

POTENTIAL SOURCES OF CONTAMINATION OF THE MEMPHIS AQUIFER

Forty-four sites where contaminants have been detected in the water-table aquifers, five municipal wells where contaminants have been detected in the Memphis aquifer, and areas where the Jackson-upper Claiborne confining unit is thin or absent are shown in plate 4. Included in the 44 sites on plate 4 are the locations of several abandoned or inactive waste-disposal dumps or landfills where contaminants were detected in the water-table aquifers during previous investigations of the USGS (Parks and others, 1982; Graham, 1985; M.W. Bradley, USGS, written commun., 1989). Included also are two private wells (Sh:J-155 and Sh:Q-93) and an industrial well (Sh:O-215) where contaminants have been detected in the water-table aquifers during another previous investigation of the USGS (McMaster and Parks, 1988).

Information concerning the 44 sites where contaminants have been detected in the water-table aquifers are given in table 6. Most of the information concerning 33 of these sites was obtained from records supplied by the offices of the appropriate Federal and State regulatory agencies, as follows:

U.S. Environmental Protection Agency
Waste Management Division
Site Investigation and Support Branch
345 Courtland Street N.E.
Atlanta, GA 30365

Tennessee Department of Health and Environment
Division of Groundwater Protection
T.E.R.R.A. Building - 5th floor
150 Ninth Avenue N.
Nashville, TN 37219-5404

Tennessee Department of Health and Environment
Division of Solid Waste Management
Room 1101, State Office Building
170 Mid America Mall N.
Memphis, TN 38103

Tennessee Department of Health and Environment
Division of Superfund
Southwest Tennessee Regional Office
295 Summar Avenue
Jackson, TN 38301-3984

Tennessee Department of Health and Environment
Division of Underground Storage Tanks
200 Doctors Building
706 Church Street
Nashville, TN 37247-4101

Table 6.--*Sites where synthetic organic compounds or relatively high concentrations of inorganic trace constituents have been detected in the water-table aquifers in the Memphis area*

[Sources: U.S. Environmental Protection Agency (EPA); Tennessee Department of Health and Environment, Division of Superfund (DSF), Division of Solid Waste Management (DSWM), and Underground Storage Tank Program (UGST); map numbers refer to plate 4 of this report]

Map number	Latitude	Longitude	Type of site	Contaminants detected	Source of information
1	352006	0895707	Millington Dump/Landfill	PCB's; cadmium	Parks and others (1982)
2	352018	0895854	Old Ordnance Dump	chlordane, endrin, mirex, toxaphene	Do.
3	352027	0895244	underground storage tank	benzene, toluene, xylenes	UGST
4	352130	0893814	industrial waste burial	2-methylphenol, phenol; chromium	EPA
5	351758	0899334	industrial spill	pesticides	DSWM
6	351548	0893856	underground storage tank	product (gasoline)	UGST
7	351755	0895750	underground storage tank	benzene, trans-1,2-dichloroethene, tetrachloroethene, toluene, trichloroethene, vinyl chloride, xylenes	Do.
8	351847	0895753	industrial spill	acetone, benzene, BHC, 2-butanone, carbon disulfide, chloroform, 4,4-DDE, 4,4-DDT, 1,1-dichloroethylene, 1,2-dichloroethylene, trans-1,2-dichloroethylene, endosulfan, heptachlor, tetrachloroethylene, toluene, trichloroethylene, vinal chloride	DSF
9	351454	0895148	private well Sh:O-93	aldrin, DDT, endosulfan, perthane	McMaster and Parks (1988)
10	351230	0900245	industrial spill	chromium	DSF
11	351225	0900159	underground storage tank	gasoline 'floating' on ground water	UGST
12	351300	0895810	underground storage tank	benzene, toluene, xylenes	Do.
13	351317	0895435	underground storage tank	benzene, toluene, ethylbenzene/xylenes	Do.
14	351215	0895131	underground storage tank	benzene, toluene, xylenes	Do.
15	351151	0895831	underground storage tank	benzene, toluene, xylenes	Do.
16	351133	0895342	underground storage tank	benzene, toluene, xylenes	Do.
17	351050	0900040	Bellevue Dump	chlordane, dieldrin, endrin, heptachlor epoxide, PCB's, phenol; arsenic, barium	Parks and others (1982)
18	351110	0895832	North Hollywood Dump area	chlordane, chlordene, cyanide, DDT, diazinon, dieldrin, diethyl phthlate, dimethyl phthlate, di-n-octyl phthlate, endrin, heptachlor, heptachlor epoxide, mirex, PCB's, phenol, 2,4,5-T; arsenic, barium, cadmium	Do. Graham (1985)
19	351005	0895150	underground storage tanks	benzene, teulene, xylenes	UGST
20	351040	0900255	industrial well Sh:O-215	barium	McMaster and Parks (1988)
21	350945	0895647	underground storge tank	acrolein, benzene, 1,2-dichloroethane, ethylbenzene, toluene	UGST
22	350915	0895808	industrial spill	1,1,1-trichloroethane	DSWM
23	350858	0895755	underground storage tank	benzene, ethylbenzene, toluene, xylenes	UGST
24	350858	0895626	underground storage tank	benzene, ethylbenzene, toluene, xylenes	Do.
25	350852	0900236	underground storage tank	benzene, toluene, xylenes	Do.

Table 6.--*Sites where synthetic organic compounds or relatively high concentrations of inorganic trace constituents have been detected in the water-table aquifers in the Memphis area*--Concluded

Map number	Latitude	Longitude	Type of site	Contaminants detected	Source of information
26	350817	0900229	underground storage tank	benzene, toluene, xylenes	UGST
27	350729	0900310	underground storage tank	benzene, ethylbenzene, toluene, xylenes	Do.
28	350755	0895050	Shelby County Landfill	benzene, chlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethane, cis-1,2-dichloroethene, trans-1,2-dichloroethylene, ethylbenzene, methylene chloride, tetrachloroethylene, trichloroethane, vinyl chloride, xylenes; arsenic, barium, chromium, lead	USGS DSWM
29	350621	0895327	underground storage tank	ethylbenzene, xylenes; other unidentified volatile organic compounds	UGST
30	350625	0895302	underground storage tank	benzene, ethlybenzene, toluene, xylenes	Do.
31	350552	0900017	military and industrial waste disposal	purgeable organic compounds	DSWM
32	350500	0900703	industrial waste disposal	benzene, ethlybenzene, tetrachloroethylene, 1,1,1 trichloroethane, trichloroethylene, toluene, vinyl chloride, xylenes	Do.
33	350507	0900458	industrial spill	petroleum products	UGST
34	350504	0900202	industrial spill	benzene, chlorobenzene, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, ethylbenzene, methylene chloride, toluene, xylenes	DSWM
35	350416	0895847	underground storage tank	benzene, toulene, xylenes	UGST
36	350442	0895307	underground storage tank	petroleum hydrocarbons	Do.
37	350405	0900255	Brooks Road Dump	chlordane, cyanide, DDT, diazinon, dieldrin, endrin, heptaclor, heptachlor epoxide, phenol	Parks and others (1982)
38	350359	0900148	underground storage tank	petroleum hydrocarbons, including diesel fuel	UGST
39	350343	0900123	underground storage tank	gasoline "floating" on ground water	Do.
40	350308	0895811	underground storage tank	benzene, ethylbenzene, toluene, xylenes	Do.
41	350203	0900349	private well Sh:J-155	aldrin, DDT, endosulfan, perthane, 1,1,1-trichloroethane	McMaster and Parks (1988)
42	350116	0900028	underground storage tank	benzene, toluene, xylenes (as total BTX)	UGST
43	350100	0895745	Jackson Pit Dump	chlordane, chlorobenzene, chloroethane, chloroform, diazinon, 1,4-dichlorobenzene, 1,1-dichloroethane, cis- 1,2,-dichloro-ethene, heptachlor, methyl parathion, methylene chloride, PCB's, phenol, tetrachloroethane, trichloroethene, toluene; arsenic, lead	Parks and others (1982) DSF
44	350230	0894125	industrial spill	chlorinated hydrocarbons	DSF

Because of the voluminous records in the files of these agencies that concern both the regulatory and investigative aspects of the sites, personnel with investigative responsibility were asked to assist by identifying those sites where contaminants have been detected in the ground water and to provide an analysis (or analyses) showing the contaminants detected. Many of the sites are still under investigation, so the information provided was from the data available at the time (1987-89).

In the selection of sites, consideration generally was not given to the degree and extent of contamination or the regulatory aspects of the definition of the word "contamination." If synthetic organic compounds have been detected in the water-table aquifers (or perched water tables), then the ground water was considered to be contaminated. Maximum contaminant levels (MCL) in drinking water have been established for some synthetic organic compounds by the U.S. EPA, but only recommended maximum contaminant levels exist for others (U.S. Environmental Protection Agency, 1986). Consequently, the presence of synthetic organic compounds in the water-table aquifers was considered an indication of contamination inasmuch as man-made organic compounds do not occur naturally in ground water. Because trace inorganic constituents occur naturally in the ground water of the Memphis area in small concentrations (Brahana and others, 1987; McMaster and Parks, 1988), these constituents are included in table 6 only if they exceeded the MCL's established by the U.S. EPA. For the trace inorganic constituents included in table 6, the MCL's are arsenic [50 micrograms per liter (μg/L)], barium (1,000 μg/L), cadmium (10 μg/L), chromium (50 μg/L), and lead (50 μg/L).

Some of the 41 sites (excluding wells Sh:J-155, Sh:O-215, and Sh:Q-93) have only one monitoring well, but others have many. Most of these monitoring wells generally are shallow (commonly less than 50 feet deep) and are screened in the upper part of the water-table aquifer, although some may be screened in perched water-table zones. Some wells have been sampled only once, but others have been sampled several times. The analyses, which were made by various commercial or government laboratories, generally are limited to reporting the synthetic organic compounds or trace inorganic constituents that are specifically important to assessing contamination based on the type of site under investigation. For example--benzene, toluene, and xylene generally are analyzed for assessing ground-water contamination at leaky underground storage tanks (table 6). These volatile organic compounds are common components of gasoline. Reported concentrations of contaminants range from trace amounts of pesticides just above the detection limits (in micrograms per liter) at some abandoned dumps to several feet of "product" floating on the ground-water surface at some industrial or underground-storage-tank sites.

Thousands of potential point and nonpoint sources of contamination of the water-table aquifers exist in the Memphis area. These sources include abandoned dumps, active and inactive landfills, underground storage tanks, industries and commercial establishments that process or use hazardous chemicals, demolition disposal sites, sewers, septic tanks, and local spills. Locations of abandoned dumps and active landfills in Shelby County, Tenn., that were known in 1975 are given in a report by Parks and Lounsbury (1976). Early in the present investigation, a list of 1,679 underground storage tanks in Shelby County was obtained from the TDHE, Division of Ground Water Protection. Personnel with that agency estimated that the list included about 70 percent of the underground storage tanks in the county, which were still being inventoried (John Fox, Jr., TDHE, oral commun., 1987). In addition, many other sites where contamination of the soils or surface waters has been detected are included in the lists of the U.S. EPA and TDHE. However, contamination of the ground water presently is known at these sites, or investigations of the sites have not progressed to the stage where ground-water contamination has been determined.

All of the above sources have potential for contaminating the water-table aquifers. Work in determining the degree and extent of contamination of the water-table aquifers is still in the beginning stage, although much progress has been made in recent years. The Memphis aquifer is a step removed from these potential sources of contamination inasmuch as under "natural" conditions contaminants must enter the water-table aquifers before they enter the Memphis aquifer.

INDICATIONS OF DOWNWARD LEAKAGE TO THE MEMPHIS AQUIFER

Indications that downward leakage from the water-table aquifers to the Memphis aquifer is widespread were provided by Graham and Parks (1986). This previous investigation used a multi-aspect approach that included studies of: (1) areal variations in the thickness of the Jackson-upper Claiborne confining unit that indicated areas where the confining unit is thin or absent, (2) the configuration of the water table that indicated an anomaly in this surface where the water table is depressed because of downward leakage, (3) differences in hydraulic head between the water-table and Memphis aquifers that indicated a general downward gradient, (4) areal and local variations in carbon-14 and tritium concentrations in water from the upper part of the Memphis aquifer that indicated relatively recent water has entered the Memphis aquifer, and (5) deviations from the normal geothermal gradient that indicated the coolest temperatures in areas of intense pumping are at greater depths (as a result of leakage) than in areas away from this pumping. The present investigation, which includes detailed studies of the thickness of the confining unit and the configuration of the water table, has resulted in much refinement of the previous work and identification of several additional areas where leakage is or may be occurring.

Graham and Parks (1986) indicated four general areas in the Memphis urban area (as defined in that report) where the Jackson-upper Claiborne confining unit is thin or absent and a high potential for downward leakage exists. These areas are: (1) in the eastern part along and north of the Wolf River, (2) in the southeastern part along Nonconnah Creek, (3) in the south-central part along Nonconnah and Johns Creeks in the vicinity of the southern part of Sheahan well field, and (4) in the western part in a belt along the Mississippi River. The areas in the eastern and southeastern parts along the Wolf River and Nonconnah Creek are extensions of the outcrop or subcrop belt of the Memphis aquifer into the Memphis urban area. The boundaries of these areas are refined on the maps prepared for the present investigation as the eastern limits of the Jackson-upper Claiborne confining unit (plates 1-4).

The area in a belt along the Mississippi River where the confining bed is shown to be thin or absent by Graham and Parks (1986, figs. 3 and 21) was significantly modified during the present investigation. The extension of the belt north of Memphis where the confining bed was thought to be thin or absent was removed from the present map showing the thickness of the Jackson-upper Claiborne confining unit (plate 1). This modification of the northern extension of the belt is based on a re-correlation of geophysical logs partly as a result of a new geophysical log made in well Sh:O-115 (plate 1). No new information from geophysical logs is available for the southern part of the belt. However, a study by Richardson (1989) indicates that water-quality changes in several wells in the Davis well field are the result of leakage of water from the Mississippi River alluvium to the Memphis aquifer.

Richardson concluded that the confining unit is thin or absent beneath the alluvium west of the Davis well field or that a "window" exists in the confining unit.

The area in the south-central part of the Memphis urban area along Nonconnah and Johns Creeks in the vicinity of the southern part of the Sheahan well field has the most information to indicate that downward leakage from the water-table aquifers to the Memphis aquifer is occurring. Indications given by Parks and Graham (1986) include: (1) a loss of water along the stretch of Nonconnah Creek south and southeast of the southern part of Sheahan well field, (2) an adjacent area to the southeast where the confining unit is thin or absent, (3) a depression in the water-table surface, (4) long-term water-level declines in shallow observation well Sh:K-75, (5) carbon-14 and tritium concentrations indicating the presence of relatively recent water in the Memphis aquifer, (6) a distorted geothermal gradient with the coolest temperature at a depth of 230 feet below land surface, and (7) head differences between the water-table and Memphis aquifers favoring downward movement of water. The area where the confining unit is thin or absent is shown on plate 1 as the large area southeast of the southern part of Sheahan well field and west of Lichterman well field. This area is enlarged from the area shown by Graham and Parks (1986, fig. 3), based partly on a new geophysical log of the test hole for well Sh:K-148 in the western part of Lichterman well field (plate 1). The depression in the water-table aquifer, shown on plate 2 as the area extending from the southern part to the northern part of Sheahan well field, also is enlarged from the area shown by Graham and Parks (1986, fig. 7), based partly on the water level in new observation well Sh:K-137.

New information from test holes for wells drilled in the northern part of Sheahan well field since the Graham and Parks report (1986) indicates an area west of that part of the well field with a high potential for leakage. The Jackson-upper Claiborne confining unit in this area is shown by Graham and Parks (1986, fig. 3) to be about 150 feet thick. The stratigraphy of the Sheahan well field is complex and faults may exist. The tops of at least two sand beds in the geologic sequence can be interpreted on geophysical logs as being the top of the Memphis Sand and two clay beds can be interpreted as being the Cook Mountain Formation. The top of the shallower clay bed underlies the fluvial deposits and varies in thickness, but it commonly is thin. The deeper clay bed is thick and seems to be persistent throughout the area. Consequently, during the Graham and Parks investigation, the lower clay was interpreted to be the Cook Mountain Formation and the underlying (deeper) sand to be at the top of the Memphis Sand. During 1986 and 1987, test holes for several new MLGW production wells were drilled in the northern part of Sheahan well field. The geophysical and driller's logs for the test hole for well Sh:K-142 (plate 1) indicate that the confining unit, if present, consisted of only about 6 feet of sandy clay (or clayey sand) overlying a thick interval of sand in the Memphis Sand. In addition, the geophysical log of well Sh:K-141 (plate 1), drilled at the Tennessee Earthquake Information Center for installation of a seismic instrument, indicated that the Cook Mountain Formation may be the shallower clay and that the top of the Memphis Sand may be at the top of the shallower sand. Based on this new information, a re-correlation of the geophysical logs available for the northern part of the Sheahan well field and surrounding areas indicates that the confining unit is thin or absent in an area west of the northern part of the well field (plate 1). This area of high potential for leakage is consistent with a depression in the water table as indicated by a deeper than expected water level in observation well Sh:K-137 (plate 2) installed at the Sheahan pumping station in 1986. In addition, in an area between the Sheahan and Allen well fields (defined by the 160-foot contour on plate 3), the potentiometric surface of the

Memphis aquifer is higher than would be expected when considering the intense pumping at these well fields. This "high" in the potentiometric surface may be the result of leakage from the water-table aquifers in the area where the confining unit is thin or absent (plate 1).

A new area of leakage from the water-table aquifers to the Memphis aquifer identified since the Graham and Parks (1986) report is just north and northeast of the Shelby County landfill (plate 4). During an investigation of the area to satisfy requirements of the TDHE, Division of Solid Waste Management, for expansion of the landfill, water levels in auger holes and observation wells drilled in the vicinity of the landfill indicated that the water table is depressed to levels below low-flow stages of the nearby Wolf River (J.L. Ashner, TDHE, oral commun., 1986). Subsequently, the USGS investigated the geohydrology of the area with emphasis on determining the effects of vertical leakage and leachate migration on the ground-water quality. The results of the investigation indicate that (1) the depression in the water table is centered just north or northeast of the landfill and is as much as 14 feet below the low-flow stages of the Wolf River, (2) a downstream loss of water from the Wolf River occurs along the stretch that flows past the landfill, (3) leachate from the landfill has entered the Wolf River alluvium and is moving northward toward the depression in the water table, and (4) uncontaminated water from the alluvium has entered the Memphis aquifer (M.W. Bradley, USGS, written commun., 1989). The map of the thickness of the Jackson-upper Claiborne confining unit indicates an area in the vicinity and east of the landfill where the confining unit is thin or absent. This is based partly on the geophysical log of well Sh:Q-90 drilled for the landfill investigation (plate 1). A depression in the water table is defined by the 220-foot contour on the map of the altitude of the water table in the alluvium and fluvial deposits. The center of this depression is near well Sh:Q-128 installed for the landfill investigation (plate 2).

New areas identified during the present investigation where the Jackson-upper Claiborne confining unit is thin or absent or where depressions are in the water table include: (1) in the southeastern part of Lichterman well field based on the geophysical log for well Sh:L-102 (plate 1), (2) in the vicinity of McCord well field based on an area east of the well field along Fletcher Creek where the confining bed is interpreted to be thin or absent (plate 1) and the lower than expected water levels in wells Sh:Q-86 and Sh:Q-94 (plate 2), (3) south of Nonconnah Creek and between Interstate 55 and U.S. Highway 78 based on the geophysical log of well Sh:K-143 (plate 1) and the lower than expected water levels in wells Sh:K-144 and Sh:K-145 (plate 2), and (4) west of Olive Branch based on the geophysical log of well Ms:C-17 (plate 1). These newly identified areas have a high potential for downward leakage from the water-table aquifers to the Memphis aquifer.

POTENTIAL FOR CONTAMINATION OF THE MEMPHIS AQUIFER

A sequence of events that would result in contamination of the Memphis aquifer under "natural" conditions is: (1) contaminants enter the water-table aquifers; (2) contaminants are transported downward through the Jackson-upper Claiborne confining unit or enter the Memphis aquifer directly in areas where the confining unit is absent; and (3) contaminants persist despite the effects of various physical, chemical, and biological processes, including dilution and adsorption. Other events that would result in contamination of the Memphis aquifer include: (1) contaminated water in the water-table aquifers leaks downward through faulty well seals (cement grout or backfill material) outside the casings of wells screened in the Memphis aquifer and (2) contaminants from spills, vandalism, or illegal waste disposal enter the casings of wells screened in the Memphis aquifer.

Based on "natural" conditions, the potential for contamination of the Memphis aquifer generally is least in the northern and west-central parts of the Memphis area where the confining bed is thickest and contains much clay, and is greatest in the southern and eastern parts where the confining bed is thin or absent (plate 1). The Jackson-upper Claiborne confining unit is as much as 375 feet thick in the northwestern part of the Memphis area in well Sh:T-18 (plate 1). In this area, the confining unit consists of fine sand, silt, clay, and lignite in the Jackson, Cockfield, and Cook Mountain Formations. The confining unit is absent in the southeastern part of the Memphis area in wells Sh:M-17, Sh:M-43, and Sh:R-10 (plate 1). Aggregate thickness of clay beds within the confining unit thicker than 10 feet is greatest in the west-central part of the Memphis area. In the Mallory well field, an aggregate thickness of clay beds thicker than 10 feet makes up 246 feet of the total thickness of 255 feet for the confining unit in well Sh:O-184 (plate 1).

Sites where the water-table and Memphis aquifers are reported to contain contaminants and areas where the Jackson-upper Claiborne confining bed is thin or absent are shown on plate 4. Thus far, 44 sites have been identified where contaminants have been detected in the water-table aquifers (table 6). Many of these sites, which are potential sources of contamination of the Memphis aquifer, are located in areas where the direction of ground-water flow in the Memphis aquifer is toward cones of depression at MLGW well fields (plate 3). Based on present (1989) information, the Allen well field has the most sites in close proximity. Some sites also are located in areas where the confining unit is thin or absent or in areas where the direction of flow in the water-table aquifers is toward these areas (plate 2). It is likely that additional sites where the water-table aquifers are contaminated will be found as monitoring and investigations continue.

Thus far, only two sites have been found where volatile organic compounds have been detected in the Memphis aquifer – wells Sh:J-119 (398 feet deep), Sh:J-120 (452 feet) and Sh:J-121 (436 feet) in the Allen well field at Memphis and wells Sh:M-31 (324 feet) and Sh:M-35 (287 feet) in the west well field at Collierville (plate 4). Volatile organic compounds detected in wells Sh:J-119 and Sh:J-120 are: 1,1-dichloroethane, 1,1-dichloroethylene, cis-1,2-dichloroethylene, 1,2-dichloropropane, 1,2-dichloroethene, trichloroethylene, and vinyl chloride. Concentrations of these compounds ranged from 0.02 to 5.52 $\mu g/L$ in these two wells – the highest concentration was for 1,2-dichloroethane detected in a sample collected from well Sh:J-120. The concentrations of the seven compounds in a sample from this well totaled about 11 $\mu g/L$ (J.H. Webb, MLGW, written commun., 1988). Well Sh:J-120 is about 650 feet and well Sh:J-119 is about 2,000 feet from the nearest known potential source of contamination in the water-table aquifers (site 34, plate 4; table 6). The wells in the Allen well field are in an area where the confining unit is as thin as 82 feet and contains as little as 68 feet of aggregate thickness of clay beds thicker than 10 feet, based on the geophysical log of well Sh:J-119 (plate 1). Driller's logs for wells Sh:J-120 and Sh:J-121 provide no indication that a sand "window" exists in this area, although it is possible.

The volatile organic compound detected in water from wells Sh:M-31 and Sh:M-35 at Collierville is trichloroethylene. Since August 1988, these two municipal wells have been sampled periodically to determine concentrations of trichloroethylene. Concentrations detected have ranged from 1.6 to 25.0 $\mu g/L$ with the highest concentration in a sample collected from well Sh:M-35 (B.J. Maness, TDHE, written commun., 1989). These wells are about 2,000 feet from the nearest known potential source of contamination (site 44, plate 4; table 6). The wells at Collierville are east of the eastern limits of the Jackson-upper Claiborne confining unit.

(plate 4). However, the driller's logs for wells Sb:M-31 and Sb:M-35 indicate at least 60 feet of clay in the Memphis aquifer separating the water-table aquifers from sand in the Memphis aquifer.

The facts that these volatile organic compounds (1) have been transported through the Jackson-upper Claiborne confining unit or through (or around) relatively thick intervals of clay in the Memphis aquifer, (2) have persisted despite the effects of various physical, chemical, and biological processes, and (3) have been detected in wells ranging from 287 to 452 feet in depth at distances as far as 2,000 feet from the nearest known potential sources of contamination in the water-table aquifers, emphasize the vulnerability of the Memphis aquifer to contamination.

Recently (1987-88), MLGW began a yearly routine sampling of all of their production wells in the Memphis aquifer and analytical "scans" of the water to determine the presence of organic compounds. If unidentified organic compounds are detected, a follow-up analysis is conducted to identify specific compounds. The results of the first sampling of all production wells indicated that only the water from the three wells in the Allen well field contained contaminants (J.H. Webb, MLGW, oral commun., 1989).

SUMMARY AND CONCLUSIONS

The City of Memphis presently (1989) depends solely on the Memphis aquifer for its water supply. Withdrawals from the Memphis aquifer in the Memphis area for municipal, industrial, and commercial uses totaled about 200 Mgal/d in 1988. Historically, the Memphis aquifer was thought of as an ideal aquifer overlain by a thick, impermeable clay layer that serves as a confining unit and protects the aquifer from contamination from near-surface sources. Studies in recent decades (1964-86), however, indicate that the confining unit locally may be thin or absent and may contain sand "windows" that could provide "pathways" for contaminants to reach the Memphis aquifer. Studies also indicate that downward leakage from the water-table aquifers (alluvium and fluvial deposits) to the Memphis aquifer is widespread in the Memphis area.

Indications of areas where downward leakage from the water-table aquifers to the Memphis aquifer is or may be occurring that were recognized during the previous and present investigations are as follows:

- areas where the confining unit is thin or absent and downward leakage can occur directly from the water-table aquifers to the Memphis aquifer;
- differences in hydraulic head between the water-table aquifers and the Memphis aquifer indicate a general downward gradient in most of the Memphis area;
- local depressions in the water-table surface indicate that leakage from the water-table aquifers to the Memphis aquifer is occurring;
- long-term declines and reduced seasonal fluctuations in observation wells in the water-table aquifers indicate that leakage is occurring;
- downstream losses of water along a stretch of a major stream based on a series of discharge measurements made during low-flow conditions indicate that leakage is occurring;
- areal and local variations in carbon-14 and tritium concentrations in water from the Memphis aquifer show the presence of relatively recent water, indicating leakage;

- local deviations in geothermal gradient in areas of intense pumping indicate that shallow subsurface temperatures in the water-table aquifers, confining unit, and Memphis aquifer are warmer than expected as a result of leakage;

- water-quality anomalies and changes in water quality in the Memphis aquifer indicate downward leakage from the water-table aquifers to the Memphis aquifer; and

- volatile organic compounds detected in water from the Memphis aquifer indicate that contaminants in water from the water-table aquifers has reached the Memphis aquifer.

Detailed maps of the thickness of the confining unit and the altitude of the water table in the alluvium and fluvial deposits prepared during the present investigation have provided much refinement of previously identified areas of downward leakage. Several new areas where downward leakage is or may be occurring also have been identified. Maps showing the altitude of the potentiometric surface of the Memphis aquifer and the locations of 44 sites where contaminants have been detected in the water-table aquifers indicate that many potential sources of contamination are located in areas where the direction of ground-water flow in the Memphis aquifer is toward cones of depression at MLGW well fields. Based on present information, the MLGW Allen well field has the most sites in close proximity. The water-table map also indicates that some of the sites where contaminants have been detected are in areas where the confining unit is thin or absent or in areas where the direction of flow in the water-table aquifer is toward these areas.

Recently, (1986-88) volatile organic compounds were detected in water from five municipal wells in the Memphis area—three in the MLGW Allen well field at Memphis and two in the west well field at Collierville. Concentrations totaled about 11.0 $\mu g/L$ for seven compounds in a sample from one of the wells at the Allen well field and 25.0 $\mu g/L$ for one compound in a sample from one of the wells at Collierville.

The facts that volatile organic compounds (1) have been transported downward through the confining unit or through (or around) relatively thick intervals of clay in the Memphis aquifer; (2) have persisted despite the effects of various physical, chemical, and biological processes; and (3) have been detected in wells ranging from 287 to 452 feet in depth at distances as far as 2,000 feet away from the nearest known potential source of contamination in the water-table aquifers, emphasize the vulnerability of the Memphis aquifer to contamination.

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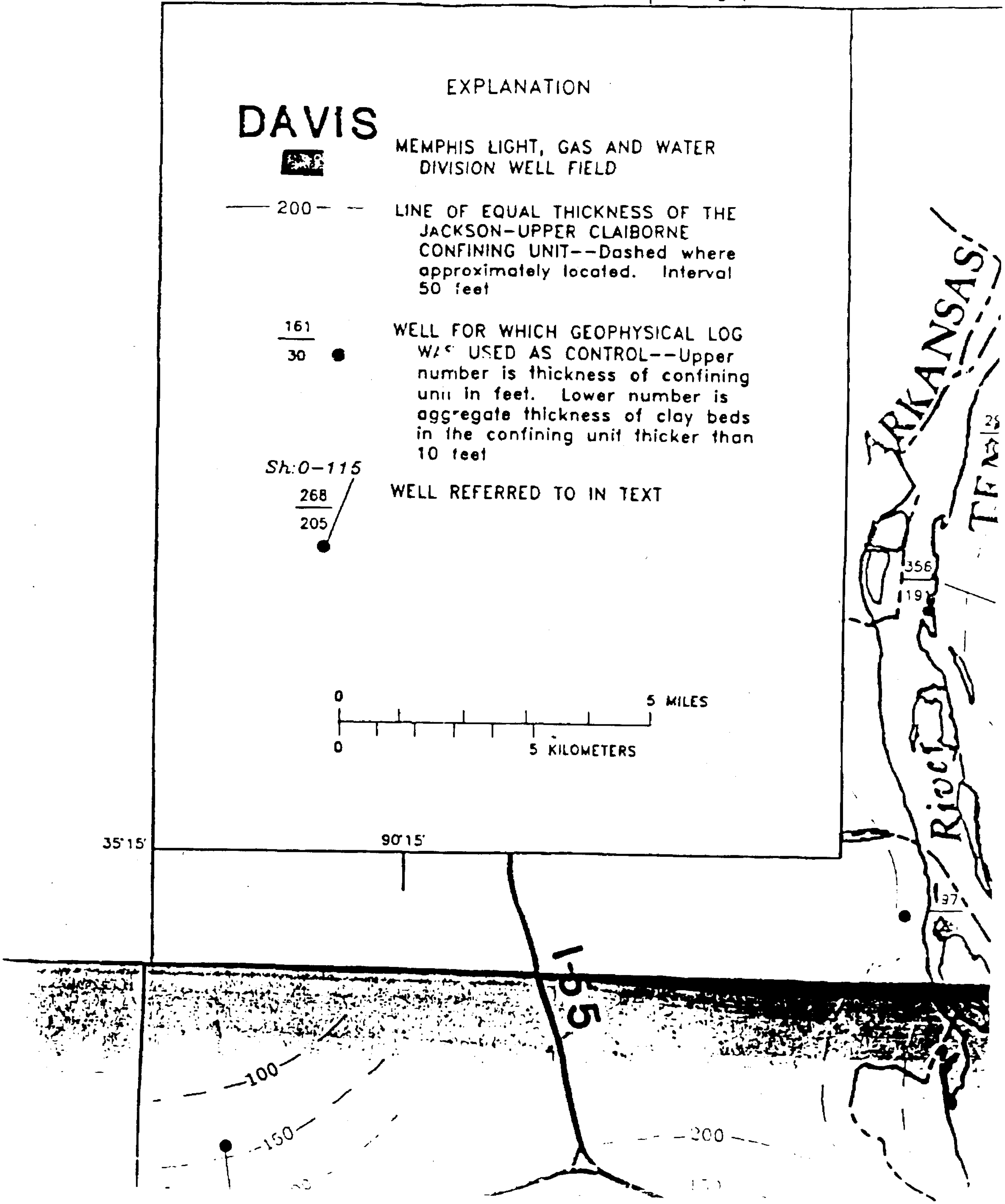
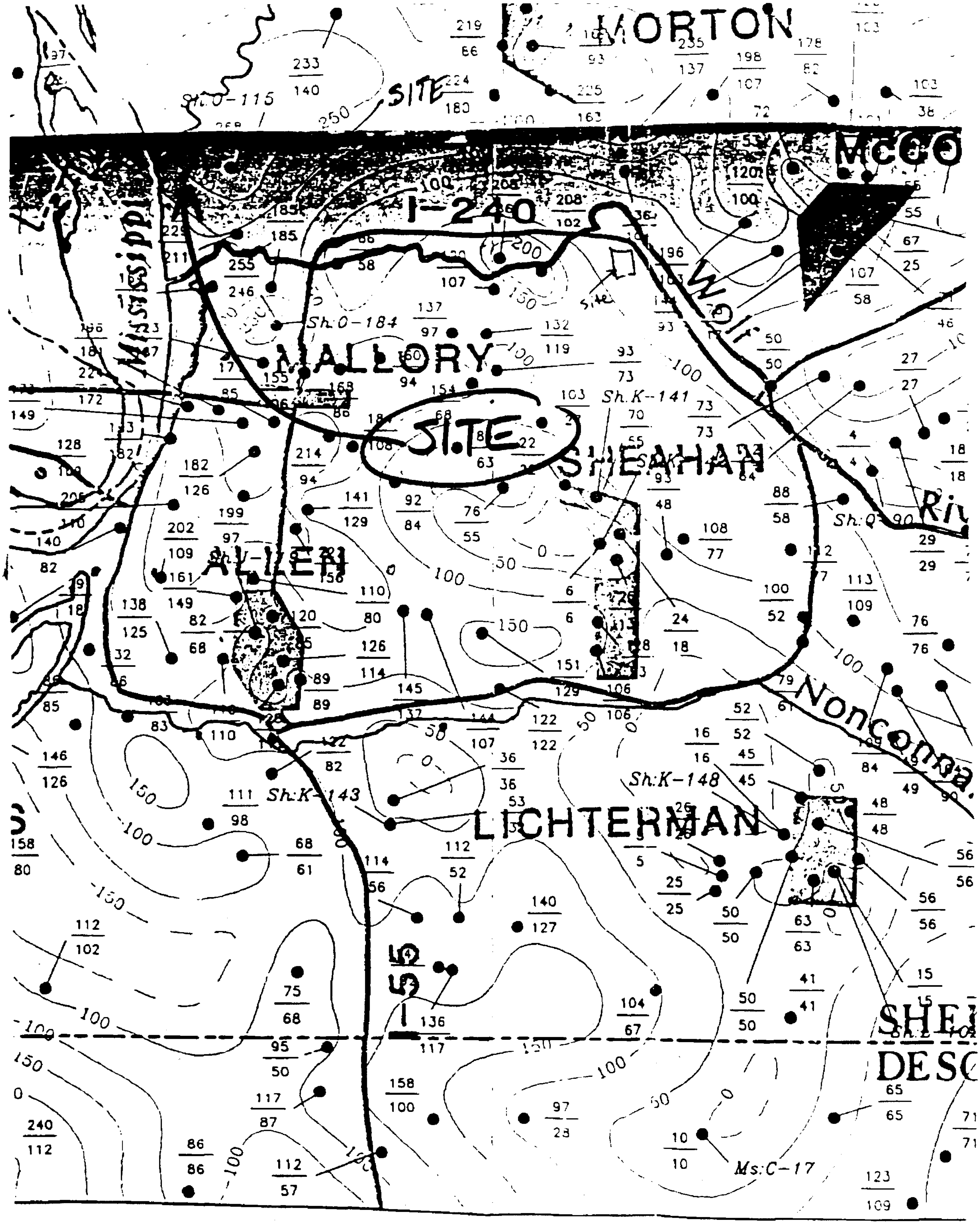
U.S. GEOLOGICAL SURVEY

PLATE 1




MORTON
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Mississippi
SITE
Sh:O-115
Sh:O-184
MALLORY
SITE
Sh.K-141
SHEAHAN
Wolf
ALLEN
Sh:Q-90
Riv
Noncon
Sh:K-148
Sh:K-143
LICHTERMAN
SHE
DESC
Ms:C-17

DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Plate 2

EXPLANATION

DAVIS — MEMPHIS LIGHT, GAS AND WATER DIVISION WELL FIELD

NSST — AREA OF NO SIGNIFICANT SATURATED THICKNESS

—— 200 — — — WATER-TABLE CONTOUR--Shows altitude of water table. Dashed where approximately located. Hachures indicate depression. Contour interval 20 feet. Datum is sea level

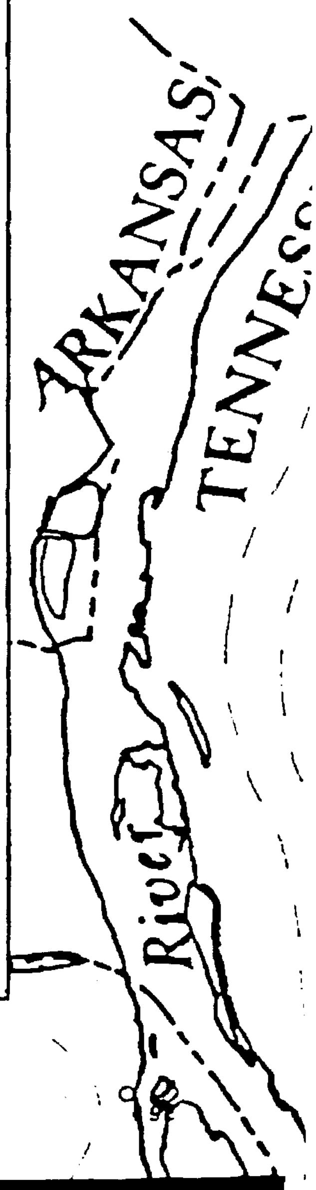
● 313 — WELL FOR WHICH WATER-LEVEL MEASUREMENT MADE IN THE FALL 1988 WAS USED AS CONTROL--Number is altitude of water level, in feet above sea level

○ 198 — WELL FOR WHICH HISTORIC (1944-87) WATER-LEVEL MEASUREMENT WAS USED AS SUPPLEMENTAL CONTROL--Number shown as less than (<) indicates altitude of water level is below bottom of well

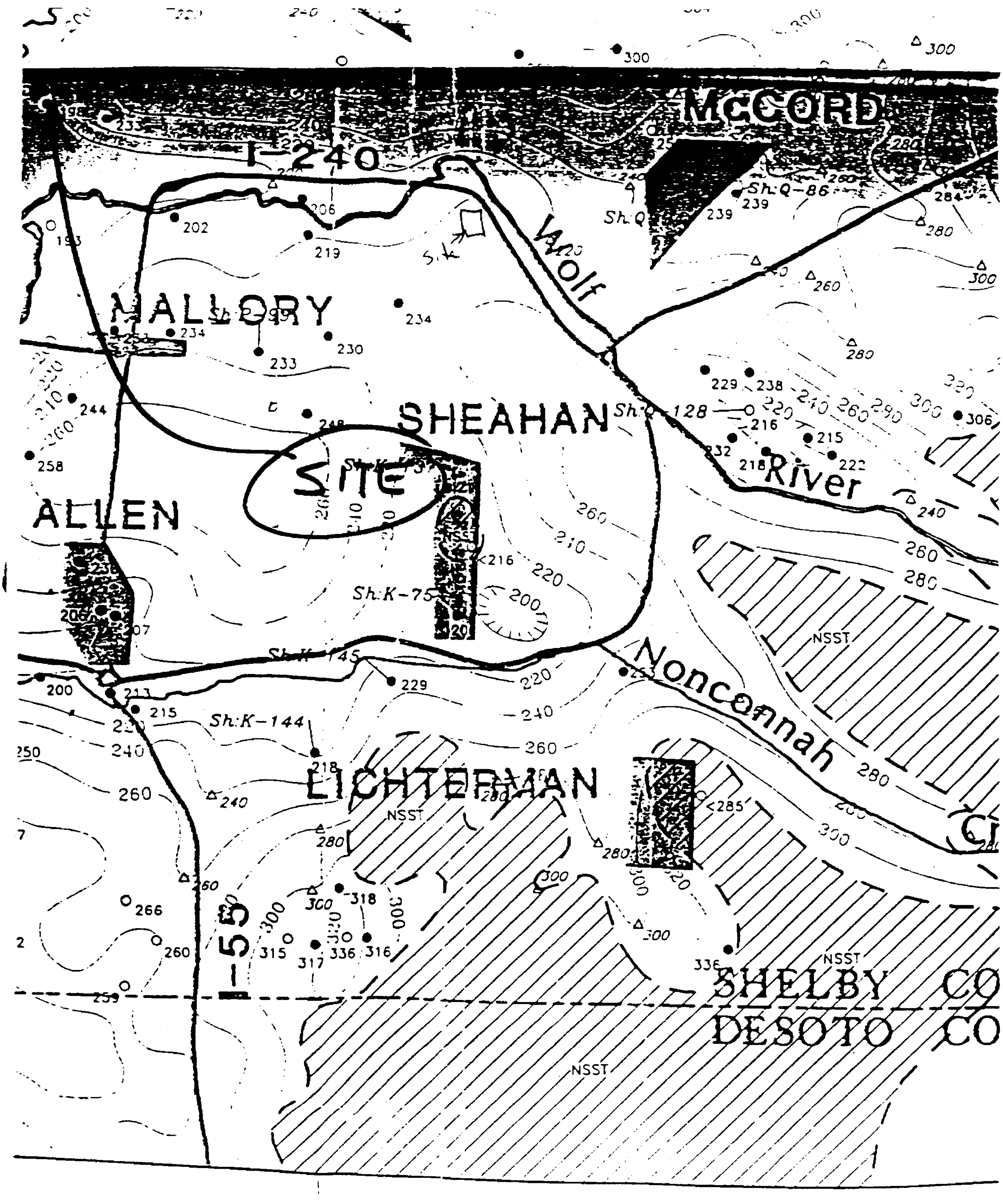
Sh:P-99 ● 233 — WELL REFERRED TO IN THE TEXT

△ *240* — POINT WHERE 20-FOOT INTERVAL CONTOUR ON 7 1/2-MINUTE TOPOGRAPHIC QUADRANGLE CROSSES PERENNIAL STREAM

35°15′ 90°15′



0 5 MILES
0 5 KILOMETERS



the water table in the alluvium and fluvial deposits in the Memphis area, Tenness

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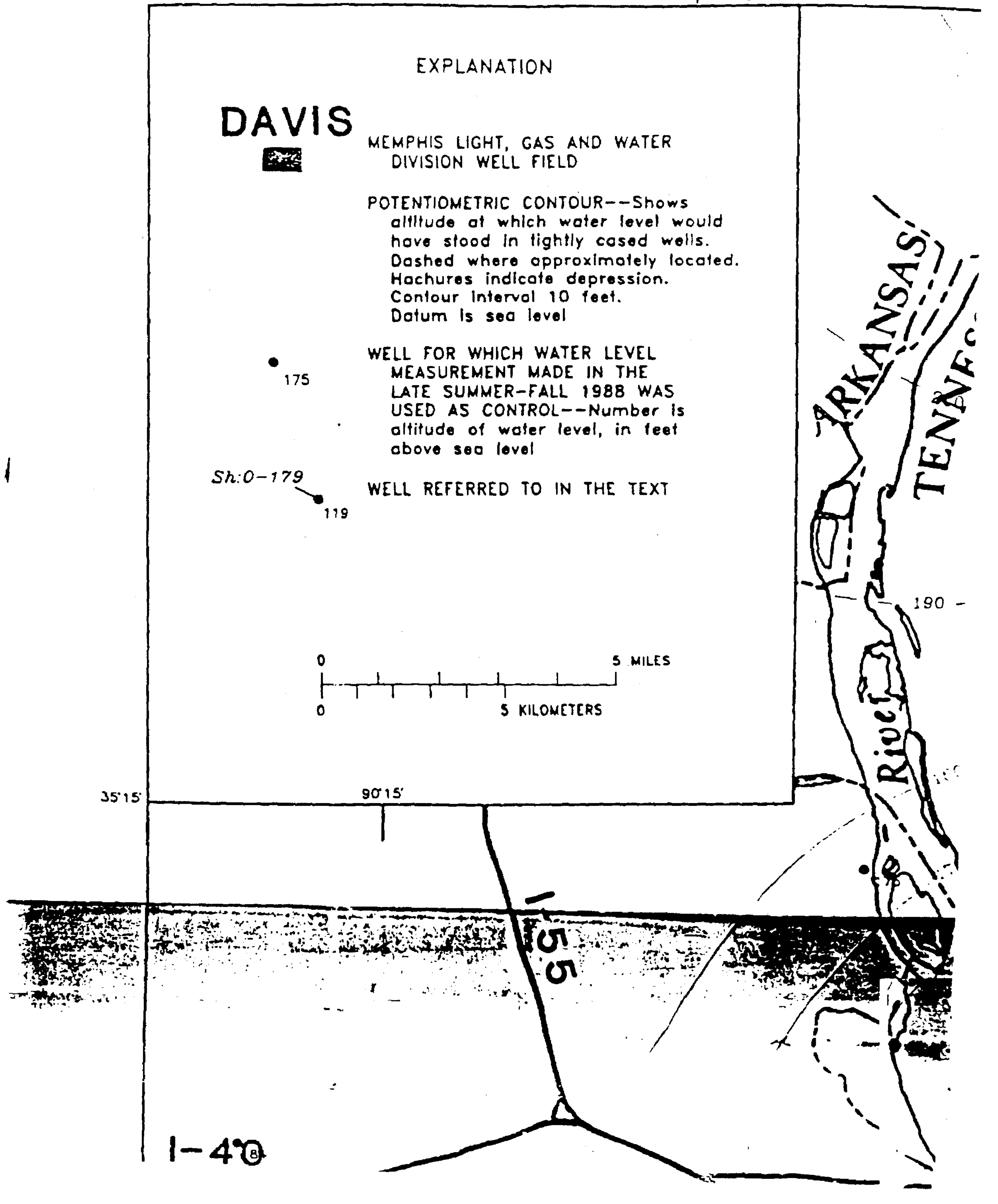
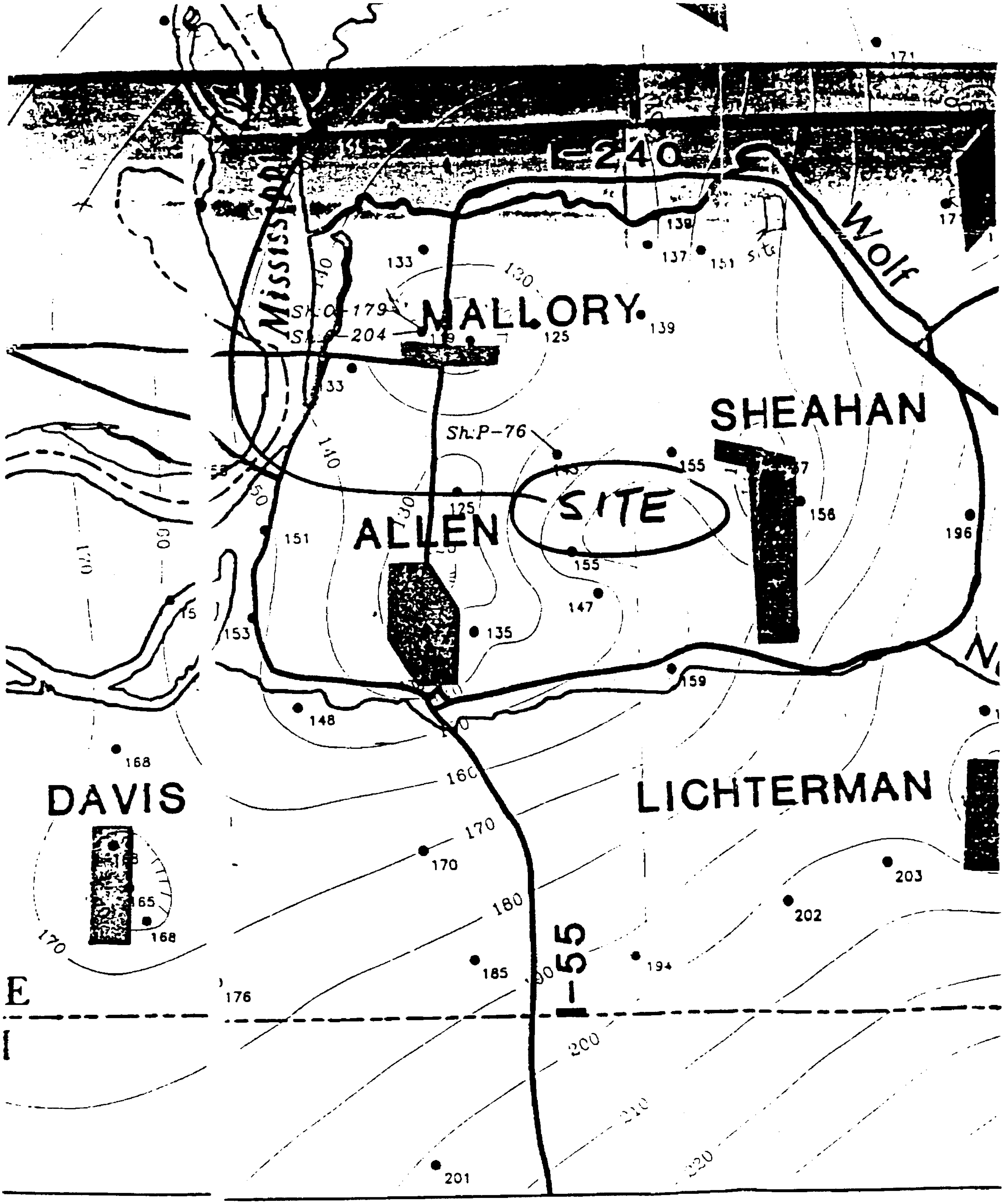
U.S. GEOLOGICAL SURVEY

PLATE 3





⊕ Altitu[illegible]e of the potentiometric surface of the Memphis aquifer in the M

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PLATE 4

EXPLANATION

DAVIS — MEMPHIS LIGHT, GAS AND WATER DIVISION WELL FIELD

AREA WHERE THE CONFINING UNIT IS THIN OR ABSENT

10 — INDUSTRIAL SPILL OR WASTE BURIAL--Number refers to sites listed in table 6

LEAKY UNDERGROUND STORAGE TANK

ABANDONED OR INACTIVE WASTE DUMP OR LANDFILL

WELL IN THE WATER-TABLE AQUIFER

WELL IN THE MEMPHIS AQUIFER

Sh:J-119 — WELL REFERRED TO IN THE TEXT

0 — 5 MILES

0 — 5 KILOMETERS

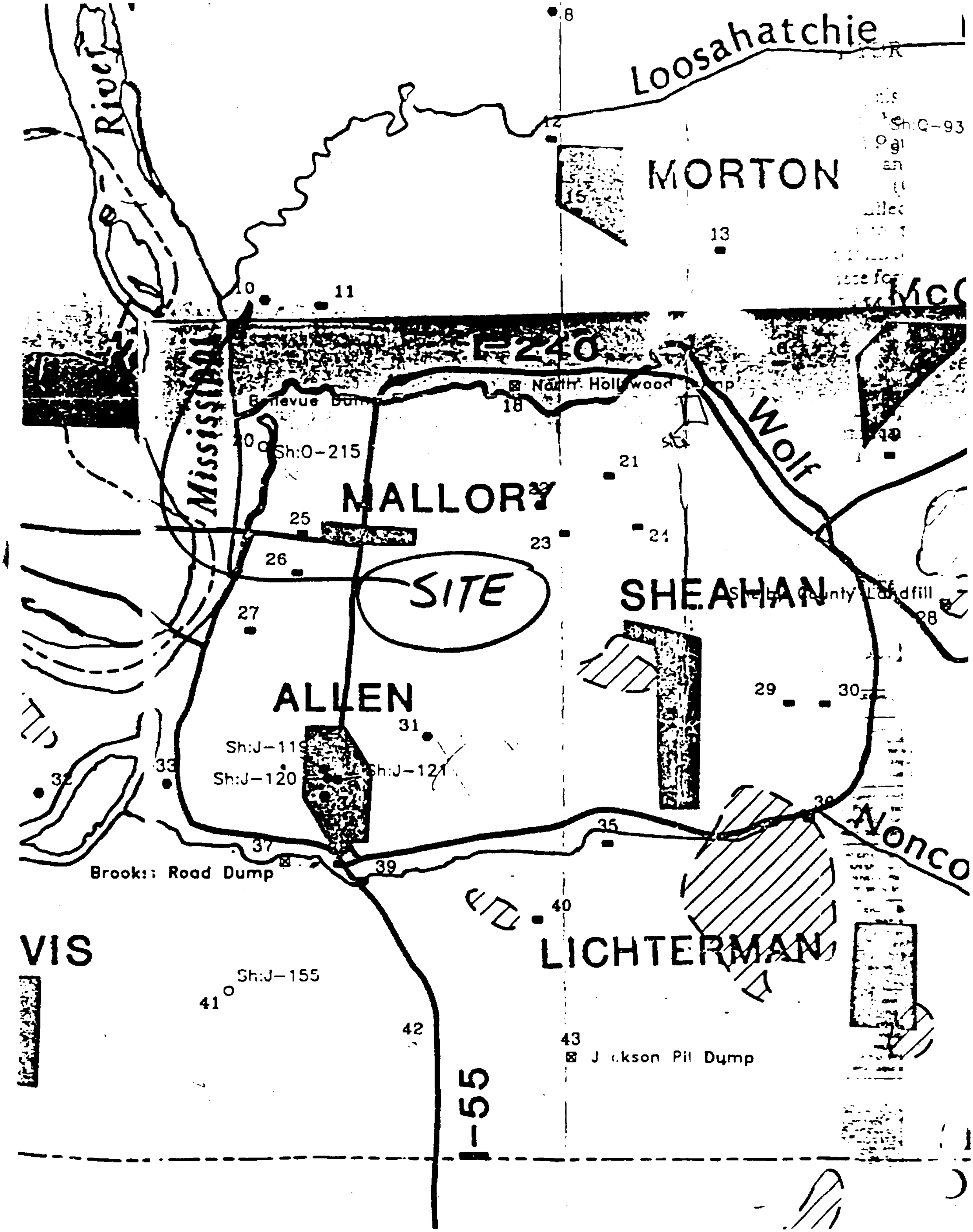
1" = 2 mi

35°15'

90°15'

ARK

I-55



Loosahatchie
River
MORTON
Sh:G-93
McC
I-240
North Hollywood Dump
Bellevue Dump
Mississippi
Wolf
Sh:O-215
MALLORY
SITE
SHEAHAN
Shelby County Landfill
ALLEN
Sh:J-119
Sh:J-120
Sh:J-121
Brooks Road Dump
Nonco
VIS
LICHTERMAN
Sh:J-155
Jackson Pit Dump
I-55
8
12
15
13
10
11
18
20
21
22
23
24
25
26
27
28
29
30
31
32
33
35
36
37
39
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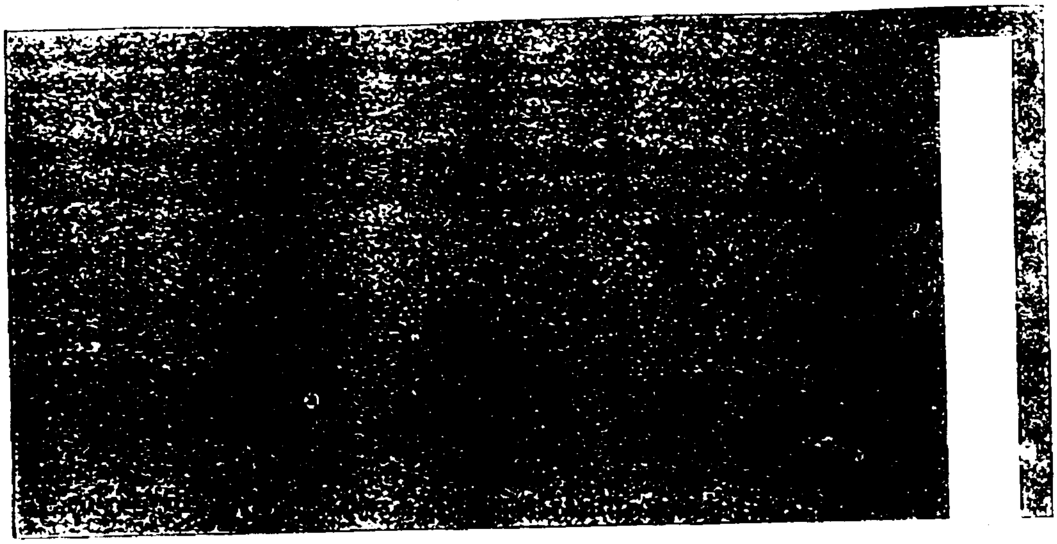
42
43

Reference 21



R. Allan Freeze

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Vancouver, British Columbia

John A. Cherry

Department of Earth Sciences
University of Waterloo
Waterloo, Ontario

GROUNDWATER

Prentice-Hall, Inc.
Englewood Cliffs, New Jersey 07632

Table 2.2 Range of Values of Hydraulic Conductivity and Permeability

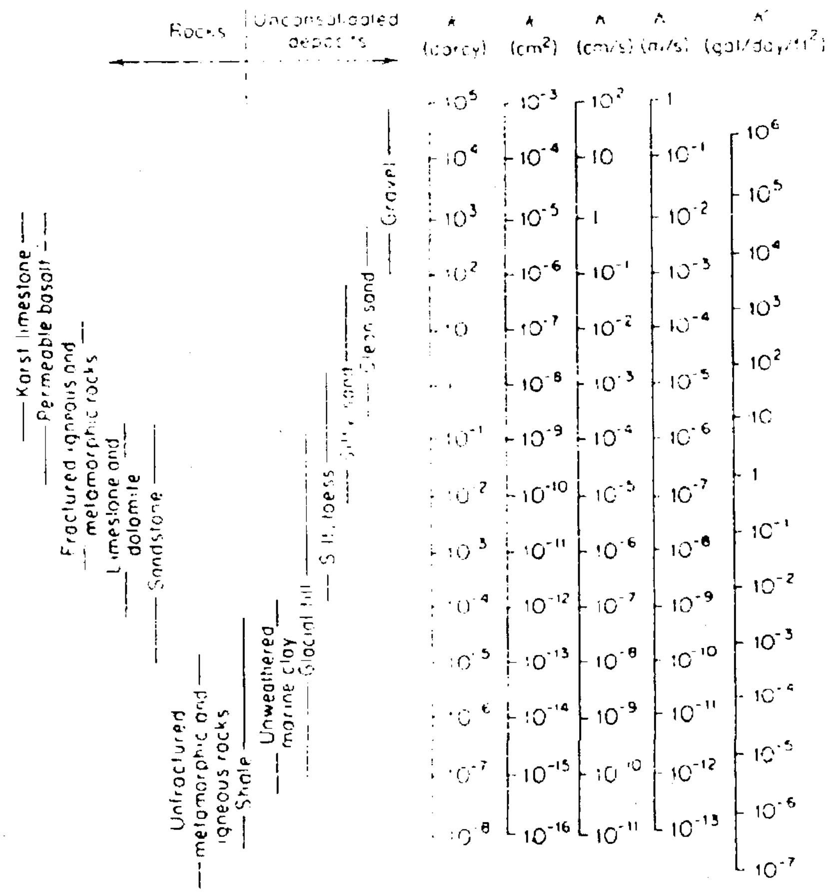


Table 2.3 Conversion Factors for Permeability and Hydraulic Conductivity Units

	Permeability, k*			Hydraulic conductivity, K		
	cm²	ft²	darcy	m/s	ft/s	U.S. gal/day/ft²
cm²	1	1.08×10^{-3}	1.01×10^{8}	9.80×10^{2}	3.22×10^{3}	1.85×10^{9}
ft²	9.29×10^{2}	1	9.42×10^{10}	9.11×10^{5}	2.99×10^{6}	1.71×10^{12}
darcy	9.87×10^{-9}	1.06×10^{-11}	1	9.66×10^{-6}	3.17×10^{-5}	1.82×10^{1}
m/s	1.02×10^{-3}	1.10×10^{-6}	1.04×10^{5}	1	3.28	2.12×10^{6}
ft/s	3.11×10^{-4}	3.35×10^{-7}	3.15×10^{4}	3.05×10^{-1}	1	6.46×10^{5}
U.S. gal/day/ft²	5.42×10^{-10}	5.83×10^{-13}	5.49×10^{-2}	4.72×10^{-7}	1.55×10^{-6}	1

*To obtain k in ft², multiply k in cm² by 1.08×10^{-3}.

Reference 22

B&V WASTE SCIENCE AND TECHNOLOGY CORP.

TELEPHONE MEMORANDUM

BVWST Project 52012.001
March 3, 1992
11:00 a.m.

Subject: Site-Specific geology & confining layer information

To: Dr. William S. Parks
Company: USGS Water Investigations
Phone No.: (901) 766-2977

Recorded by: Carter Helm

Since there exists no mention of hydraulic conductivity values for aquitards in the Memphis area in Dr. Parks' publication Hydrogeology and Preliminary Assessment of the Potential for Contamination of the Memphis /Aquifer in the Memphis Area, TN, I asked Dr. Parks if the range 1.0 x 10^{-7} to 1.0 x 10^{-5} cm/sec is acceptable for the Jackson-Upper Claiborne clay confining unit. He said it is highly variable but the estimation I extracted from Freeze and Cherry appears to somewhat accurately describe the aquitard.

Reference 23

Hydrology of Aquifer Systems in the Memphis Area, Tenness

By J. H. CRINER, P-C. P. SUN, and D. J. NYMAN

CONTRIBUTIONS TO THE HYDROLOGY OF TH

GEOLOGICAL SURVEY WATER-SUPPL

Prepared in cooperation with the city (Memphis, Memphis Light, Gas, an Water Division

A hydrogeologic delineation, analysis, an evaluation of the principal water-bearin formations in the Memphis area, Tennesse

UNITED STATES DEPARTMENT OF THE INTERIOR

STEWART L. UDALL, *Secretary*

GEOLOGICAL SURVEY

Thomas B. Nolan, *Director*

CONTENTS

ILLUSTRATIONS

[Plates are in pocket]

TABLES

CONTRIBUTIONS TO THE HYDROLOGY OF THE UNITED STATES

HYDROLOGY OF AQUIFER SYSTEMS IN THE MEMPHIS AREA, TENNESSEE

By J. H. CRINER, P-C. P. SUN, and D. J. NYMAN

ABSTRACT

The Memphis area as described in this report comprises about 1,300 square miles of the Mississippi embayment part of the Gulf Coastal Plain. The area is underlain by as much as 3,000 feet of sediments ranging in age from Cretaceous through Quaternary.

In 1960, 150 mgd (million gallons per day) of water was pumped from the principal aquifers. Municipal pumpage accounted for almost half of this amount, and industrial pumpage a little more than half. About 90 percent of the water used in the area is derived from the "500-foot" sand, and most of the remainder is from the "1,400-foot" sand; both sands are of Eocene age. A small amount of water for domestic use is pumped from the terrace deposits of Pliocene and Pleistocene age.

Both the "500-foot" and the "1,400-foot" sands are artesian aquifers except in the southeastern part of the area; there the water level in wells in the "500-foot" sand is now below the overlying confining clay. Water levels in both aquifers have declined almost continuously since pumping began, but the rate of decline has increased rapidly since 1940. Water-level decline in the "1,400-foot" sand has been less pronounced since 1956.

The cones of depression in both aquifers have expanded and deepened as a result of the annual increases in pumping, and an increase in hydraulic gradients has induced a greater flow of water into the area. Approximately 135 mgd entered the Memphis area through the "500-foot" sand aquifer in 1960, and, of this amount, 60 mgd originated as inflow from the east and about 75 mgd was derived from leakage from the terrace deposits, from the north, south, and west and from other sources. Of the water entering the "1,400-foot" sand, about 5 mgd was inflow from the east, and about half that amount was from each of the north, south, and west directions. The average rate of movement of water outside the area of heavy withdrawals is about 70 feet per year in the "500-foot" sand and about 40 feet per year in the "1,400-foot" sand. The average rate of depletion of storage in each aquifer since pumping began is about 1 mgd.

Most of the recharge to the "500-foot" and "1,400-foot" sands occurs in outcrop areas about 30–60 miles east of Memphis. Also, water leaks from the terrace deposits to the "500-foot" sand in some places, and there may be some leakage from streams where the confining clay is thin or is breached by faults or streams.

The quality of water from both the principal aquifers is very good. Iron, carbon dioxide, and hydrogen sulfide are the only constituents found in undesirable quantities. Water from the terrace deposits is hard but generally contains less iron and carbon dioxide than water from either of the principal aquifers.

The hydraulic characteristics of both aquifers were determined by pumping tests and by applying the knowledge of the geology of the area; these characteristics indicate that the aquifers are capable of producing more water than is currently being pumped from them. The "500-foot" sand will produce more water per unit decline of water level than will the "1,400-foot" sand. There appears to be no reason why the development of water supplies from both aquifers should not continue, but well spacing will remain a factor which could affect future development. Greater well spacing will tend to prolong the useful life of a well and the aquifers.

INTRODUCTION

In 1960, industrial and municipal supply wells in the Memphis area pumped about 150 million gallons of water a day. Pumping has increased continuously since 1898, the earliest date for which records are available, and the rate of this increase has accelerated greatly since 1940. Decline of water levels has accompanied increases in the pumpage, and in 1928 the city of Memphis began a program of periodic water-level measurements to determine ways to reduce the rate of decline. The U.S. Geological Survey was requested to assist in this study, and a continuing cooperative program of investigations was begun in 1940. Early investigations showed the need for proper spacing of wells, which has been practiced to the present time.

PURPOSE AND SCOPE OF INVESTIGATION

The present investigation was started in 1958 as a quantitative study of the two principal aquifers that supply water to the Memphis area. The objectives were to delineate these aquifers, evaluate their hydraulic characteristics, show the relation between pumpage and water-level change, and determine the factors affecting the economical development and use of ground water. The study was based partly on the premise that the questions posed by Kazmann (1944, p. 17-18) must be answered as completely as possible to provide for orderly development and management of the ground-water resources. These questions are repeated and discussed in the concluding section of this report.

Work consisted of (1) delineation of the "500-foot" and "1,400-foot" sands by a series of subsurface contour maps based on drillers' logs and geophysical logs of wells, (2) collection of water-level records from a network of about 150 observation wells, 55 of which were equipped with automatic recorders, (3) preparation of contour maps showing water levels and the amount of water-level decline in the "500-foot" sand, (4) analyses of pumping tests of wells ...

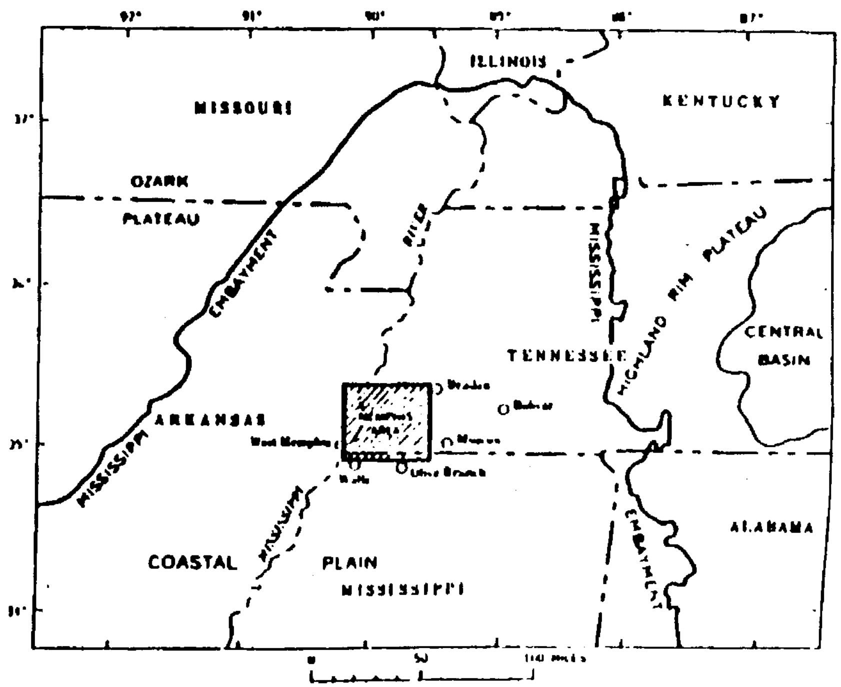
area through each aquifer before development began and during 1960, (6) preparation of a ground-water budget for the "500-foot" sand, based on 1960 records, and (7) inventory of ground-water withdrawal and study of its relation to water-level decline.

LOCATION AND GENERAL FEATURES OF THE AREA

The Memphis area (fig. 1), about 1,300 square miles in this report, includes all Shelby County and parts of Fayette and Tipton Counties, Tenn., and contiguous parts of Arkansas and Mississippi. The area is near the center of the upper half of the Mississippi embayment in the Gulf Coastal Plain.

The climate of the Memphis area is warm and humid, having hot summers, mild winters, and a frost-free period of about 230 days between late March and early November. The average annual temperature is 61.9°F; the hottest month is July, which has an average temperature of 81.1°F; and the coldest month is January, which has an average temperature of 41.5°F.

The average annual rainfall Memphis (fig. 2), based on an 89-year period of record (1872–1960), is 48.48 inches. The maximum annual rainfall recorded was 76.85 inches in 1957, and the minimum was 30.54



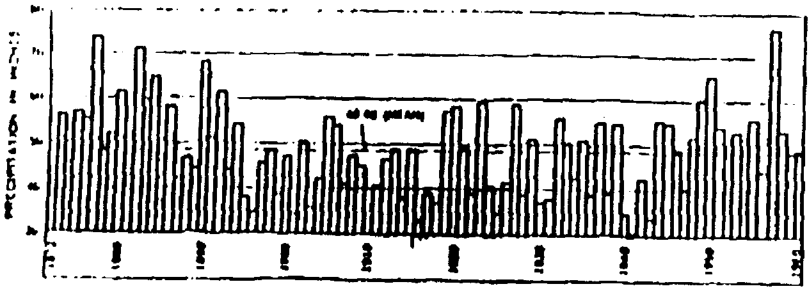


FIGURE 2.—Graph showing annual precipitation at Memphis, Tenn.

inches in 1941. The wet season usually begins in late November and ends in April. Rainfall at Moscow and Bolivar (fig. 1) in the outcrop or recharge area of the principal aquifers, is slightly greater than that in the Memphis area.

The Memphis area (fig. 1) consists mostly of a gently rolling upland ranging in elevation from about 400 feet in the eastern part of Shelby County to about 200 feet on the alluvial plain of the Mississippi River. The maximum topographic relief is about 200 feet, but the local relief of individual topographic features seldom exceeds 40 feet. The upland area is terminated by a bluff 50 to 150 feet high along the eastern margin of the alluvial plain of the Mississippi River. This virtually flat plain, which is approximately 210 feet above sea level, is about 3 miles wide along the east side of the Mississippi River except in the vicinity of Memphis; at Memphis the river flows along the base of the bluff.

The principal streams that drain the Memphis area are the Wolf and Loosahatchie Rivers and Nonconnah Creek, all of which flow north-northwestward and discharge into the Mississippi River. These streams have wide flood plains that are generally adequate to accommodate flood waters during the rainy season. Some sections of the channels of these and smaller tributaries have been artificially deepened for more effective drainage of the lowland areas. In the past all three major streams have flowed throughout the year; however, in recent years Nonconnah Creek was dry in its lower reach for short periods during the dry season from July to October.

Memphis is a large industrial center; the principal industries produce hardwood lumber and cotton and associated products. The Memphis Chamber of Commerce reported 765 industries in Memphis (1958-59), 120 of which have their own water-supply wells. More than half the total ground-water pumpage from the area is from these wells.

The 1960 U.S. Census shows that the population of Memphis and Shelby County has approximately doubled since 1930. The successive census figures are as follows:

Population of Memphis and Shelby County, Tenn.

Year	Memphis	Shelby County
1930	253,143	306,482
1940	292,942	358,250
1950	396,012	482,393
1960	497,524	627,019

PREVIOUS INVESTIGATIONS

The earliest reports describing the geology and the ground-water resources of the Memphis area were by Safford (1869, 1890) and Glenn (1906). Wells (1931) described the artesian water supply of Memphis and, in a subsequent report (1933), the ground-water resources of West Tennessee, including a more detailed discussion of ground-water conditions in the Memphis area. Since the beginning of the cooperative program in 1940, progress reports have been published by Kazmann (1944), Schneider and Cushing (1948), and Criner and Armstrong (1958).

Regional and local studies relating to the geology of the Memphis area were made by Fisk (1944), Caplan (1954), Stearns and Armstrong (1955), and Stearns (1957).

Records of water levels from 1936 through 1955 have been reported by the U.S. Geological Survey (issued annually). Earlier measurements were reported by Wells (1931, 1933).

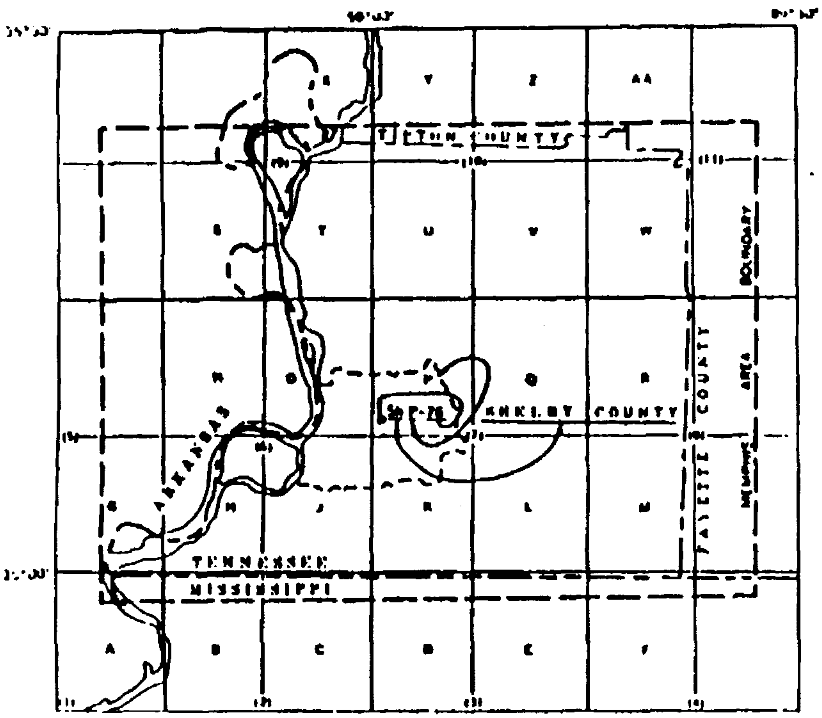
ACKNOWLEDGMENTS

The assistance and cooperation of many city and county officials, industry representatives, drilling contractors, and well owners were helpful in the collection of data for this report. Mr. J. J. Davis, Director, Water Division, and Messrs. A. J. Rundey and Hugh Mills, Memphis Light, Gas, and Water Division, provided essential well and water-use data from the city records and assisted greatly in the investigation. Mr. E. C. Handorf and Mr. W. M. Craddock, of the Memphis and Shelby County Health Department have, through their interest in the Memphis area water supply, contributed substantially to the study. Drilling contractors, industries, and individual well owners also were especially helpful in providing well data, permitting use of wells for geophysical and hydraulic tests, and furnishing information on water use in the area.

WELL-NUMBERING SYSTEM

Figure 3 illustrates the standard system for numbering wells in this report. Each well number consists of of three units: (1) an abbreviation of the name of the county in which the well is located; (2) a letter designating the 7½-minute topographic quadrangle, or 7½-minute quadrant of a 15-minute quadrangle, in which the well is located; and (3) a number generally indicating the numerical order in which the wells were inventoried.

The index map (fig. 3) shows the 15-minute topographic quadrangles of the U.S. Army Corps of Engineers that include Shelby County and adjacent areas described in this report. The example, well Sh: P-76, is in Shelby County, in the northwest quadrant (7½-minute quadrangle designated "P") of the Bartlett 15-minute quadrangle and is identified as well 76 in the numerical sequence.



15-MINUTE TOPOGRAPHIC QUADRANGLES

1. HORSESHOE LAKE (1954) NE¼
2. HORN LAKE (1961) NW¼
3. HERNANDO (1964) NW¼
4. BYHALIA (1940) NW¼
5. EDMONDSON (1951) SE¼
6. MEMPHIS (1961)
7. BARTLETT (1961)
8. COLLIERVILLE (1940) W½
9. JERICHO (1962)
10. MILLINGTON (1961)
11. MASON (1954) W½

In this report the county designation "Sh" is omitted in figures. Well numbers in adjoining counties in Tennessee are preceded by the county abbreviation. Wells in adjoining States are not numbered.

At Memphis, the Memphis Light, Gas, and Water Division many years ago established their own well-numbering system. According to this plan, blocks of numbers were assigned for the city's five existing well fields (pl. 1) and other blocks of numbers were reserved for future well fields. The block assignments are as follows:

1-40	Parkway Field	200-240	McCord Field
50-90	Sheahan Field	250-290	(Not assigned)
100-140	Allen Field	300-340	Hickory Hill (Lichterman) Field (proposed)
150-190	Miscellaneous wells at scattered locations (abandoned)		

Listed below are city-owned wells in use as of January 1962 and those that have been withdrawn from use. Well numbers followed by the letters "A," "B," and so on, indicate first, second, and so on, replacement wells for those withdrawn from use. For convenient reference, the wells owned by the Memphis Light, Gas, and Water Division are listed below, together with the corresponding numbers assigned by the U.S. Geological Survey.

City	Geological Survey	City	Geological Survey	City	Geological Survey
1	Sh:O-125	15A	Sh:O-150	30	Sh:O-175
1A	126	16	151	31	176
2	127	16A	152	32	177
2A	128	17	153	33	178
3	129	18	154	34	179
4	130	19	155	35	180
4A	131	19A	156	36	P-77
5	132	20	157	37	78
6	133	20B	158	38	O-181
6A	134	21	159	39	182
7	135	21A	160	40	183
7A	136	22	161	41	184
9	137	22A	162	42	185
9A	138	22B	163	43	186
10	139	22C	164	44	187
10A	140	23	165	45	188
11	141	23A	166	46	189
11A	142	24	167	47	190
12	143	24A	168	50	K-37
12A	144	25	169	51	38
13	145	26	170	52	39
13A	146	26A	171	53	40
14	147	27	172	54	41
14A	148	28	173	54A	42
15	149	29	174	55	43

City	Geological Survey	City	Geological Survey	City	Geological Survey
55A	Sh: K- 44	80	Sh: P- 84	123	Sh: J-116
56	45	81	K- 69	124	117
57	46	82	70	125	118
57A	47	83	71	126	119
57B	48	84	72	127	120
57C	49	85	73	128	121
58	50	86	74	130	122
59	51	86S	75	131	123
60	52	87	76	133	124
61	53	88	77	134	125
61A	54	101	J- 96	135	126
62	55	102	97	136	127
63	56	103	98	137	128
64	57	104	99	193	P- 76
65	58	105	100	201	Q- 29
66	59	106	101	202	30
67	60	107	102	203	31
68	61	108	103	204	32
69	62	109	104	205	33
70	63	110	105	207	34
71	64	111	106	208	35
72	65	112	107	209	36
73	66	113	108	210	37
74	P- 79	114	109	218	38
75	80	115	110	219	39
76	81	116	111	220	40
77	K- 67	117	112	221	41
77A	68	118	113	222	42
78	P- 82	121	114	307	L- 39
79	83	122	115	324	40

GENERAL GEOLOGY OF THE AQUIFER SYSTEMS

The Memphis area is in the northern part of the East Gulf Coastal Plain, near the axis of the Mississippi embayment structural trough (fig. 1). About 3,000 feet of unconsolidated clay, silt, sand, and gravel has been deposited in this area, and these sediments provide a record of the several invasions and recessions of the sea and the intervening periods of erosion that have occurred since the beginning of Cretaceous time. This wedge-shaped sequence of deposits thickens southward toward the Gulf of Mexico and westward toward the Mississippi River.

Stearns and Armstrong (1955, p. 6-7) and Stearns (1957, p. 1084-1085) described the depositional environmental relations and defined three sedimentary rock types that best illustrate these relations in the northern part of the Mississippi embayment. These types are described briefly as follows:

Back-beach clay and sand.—Back-beach beds consist of light-colored clay, lignite, and discontinuous beds of sand. The clay beds, in contrast with those of a more marine environment, are characterized by the presence of leaf imprints and the general absence of glauconite. These clay and sand deposits are of limited areal extent and therefore cannot be traced easily in the subsurface, even by means of geophysical logs of closely spaced wells. The irregularly interbedded sediments in the upper part of the Claiborne Group (table 1) are typical of the back-beach deposits.

Shallow-water near-shore sand.—Well-sorted sand interbedded with glauconitic and fossiliferous clay is characteristic of the shallow-water near-shore deposits. The sand is areally extensive, in contrast with the back-beach deposits. Where sand beds grade laterally or vertically into back-beach beds, they contain lignite and wood fragments; where they grade into deeper-water clay beds, they contain glauconite. The sandy middle unit ("1,400-foot" sand) of the Wilcox Group (table 1) in the Memphis area is typical of the shallow-water near-shore deposits.

Deeper water clay and shale.—The deeper water clay and shale is medium gray to dark gray and contains marine fossils, calcareous beds, and glauconite. These beds are thick and areally extensive and therefore are easily recognized and traced in the subsurface by means of drillers' logs and geophysical logs of wells. In the Memphis area, typical deposits of this category are the marine facies of the Jackson(?) Formation and the upper clay unit of the Wilcox Group.

DESCRIPTION OF THE GEOLOGIC UNITS

The Memphis area is underlain by about 3,000 feet of clay, silt, sand, and gravel ranging in age from Cretaceous through Recent. These sediments were deposited on the limestone rocks of Paleozoic age that form the bedrock floor of the Mississippi embayment syncline. This report deals primarily with the geology related to the two principal aquifers in the Memphis area, and for this reason only the stratigraphic units of Eocene and younger age are discussed in detail. These units (table 1) include the major aquifers, the "1,400-foot" sand of the Wilcox Group, and the "500-foot" sand of the Claiborne Group (Kazmann, 1944, p. 2).

WILCOX GROUP

On the basis of drillers' logs and geophysical logs of wells in the Memphis area, the Wilcox Group is divided into a lower clay unit, a middle sand unit ("1,400-foot" sand), and an upper clay unit (Criner and Armstrong, 1958, p. 3).

The lower unit of the Wilcox Group consists of gray to greenish-gray lignitic clay which grades upward into silt and fine-grained sand deposits. The percentage of sand increases upward in this unit, perhaps representing a transitional phase between the marine Porters

TABLE 1.—*Geologic units underlying the Memphis area*

System	Series	Group	Stratigraphic unit	Thickness (feet)	Description and relation to water
Quaternary	Recent		Alluvium	0-200	Alluvial sand, clay, and gravel. Few domestic wells. Could be important source of water for some industrial uses.
	Pleistocene		Loess	0-100	Wind-deposited silt. (Topographically higher than alluvium.) Low permeability. Not a source of ground water.
	Pliocene and (or) Pleistocene[1]		Terrace deposits	0-100	Alluvial sand and gravel. Several domestic wells. Could be major source of water for industrial and irrigation uses.
Tertiary	Eocene		Jackson(?) Formation (lower part may include some Claiborne beds)	0-350	Gray, bluish-gray, greenish-gray, and tan clay; minor amounts of lignite and fine-grained sand. Generally impermeable and considered to be upper confining beds for water in "500-foot" sand.
		Claiborne	"500-foot" sand (upper part may include some Jackson(?) beds)	400-900	Fine- to coarse-grained sand; minor amounts of lignite and tan clay and silt; thin clay and lignite lenses. Thick clay bed locally at base. Coarse channel sands locally at base. Very good aquifer from which 90 percent of water in Memphis area is obtained.
		Wilcox	Flour Island Upper clay unit	200-395	Gray, greenish-gray, and brown carbonaceous clay. Thin lignite and fine-grained sand lenses locally. Low permeability confines water in "500-foot" and "1,400-foot" sands.
			Middle sand unit ("1,400-foot" sand)	150-300	Fine- to medium-grained sand; minor amounts of lignite and clay lenses. Second principal aquifer which supplies about 10 percent of water used in Memphis area.
			Lower clay unit	190-250	Gray, greenish-gray, and brown carbonaceous clay, and lignite; sandy near top. Impermeable lower confining bed for water in "1,400-foot" sand.

[1] See p. O30.

Porters Creek Clay and the predominately sandy middle unit of the Wilcox. The clay unit ranges in thickness from 190 feet in test well Fa: W-1 about 30 miles northeast of Memphis near Braden, Fayette County, to 250 feet in well Sh: U-12, 3.5 miles south of Millington, Shelby County (pl. 1).

1400 Sand The middle sand unit, referred to as the "1,400-foot" sand by Criner and Armstrong (1958, p. 3), consists mostly of unconsolidated well-sorted fine- to medium-grained sand. Logs of a few wells in the Memphis area show thin interbedded lenses of clay, but these beds probably are not areally extensive. The sand ranges in thickness from 150 feet in test well Fa: W-1 near Braden, Fayette County, to 240 feet in well Sh: U-12, 3.5 miles south of Millington, Shelby County (pl. 1). The thickness increases westward to 300 feet in an oil-test well 7 miles west of West Memphis, Ark.

Flour Island The upper unit of the Wilcox Group in the Memphis area consists of dark-gray or brown lignitic clay containing local lenses of silty and sandy clay from 1 to 50 feet thick. Thin beds of fine-grained sand cemented with iron oxide form "rock" layers a few inches thick in many parts of the unit. The upper clay of the Wilcox grades upward to a sandy clay; however, the contact with the overlying sand of the Claiborne Group is distinct, as is indicated by geophysical logs (pl. 1) of wells in the area. The thickness of the upper clay section varies greatly, ranging from 200 to 395 feet in the Sheahan well field in the south-central part of Shelby County.

CLAIBORNE GROUP

The Claiborne Group in the Memphis area is represented by the "500-foot" sand, which has been divided into lower and upper parts by Criner and Armstrong (1958, p. 7–8). This subdivision was based on the different lithologies of the two parts and on their separation in much of the area by clay beds as much as 150 feet thick. Electrical logs and drillers' logs of wells show that the lower part of the Claiborne varies greatly in thickness and contains a greater number of clay beds that are thicker and more extensive than those in the upper part. Even the thickest of the clay beds, however, are not continuous, so that no particular bed can be considered as a hydrologic boundary between distinctive lower and upper parts. In this report, therefore, the "500-foot" sand is considered as a single hydrologic unit. Generally the Claiborne Group is characterized by a greater proportion of clay in the lower part and by a gradation in sand particle size from fine to medium grained in the lower part to medium to coarse grained in the upper part. The thickest and most extensive clay bed underlies the central part of the Memphis area and is in the lower part of the Claiborne Group.

The thickness of the Claiborne Group ranges from 500 feet in test well Fa: W-1 near Braden, Fayette County, to 800 feet in well Sh: J-101 in the southern part of the city of Memphis (pl. 1). The top of the "500-foot" sand was indicated in geophysical logs of wells as the level at which the sediments change from predominantly sand to predominantly clay or silt. The contacts were picked to define a hydrologic unit ("500-foot" sand regardless of geologic age. For this reason the upper part of the unit as shown on plate 1 may include some sandy beds belonging to the overlying Jackson(?) Formation.

JACKSON(?) FORMATION

The Jackson(?) Formation overlies and confines the "500-foot" sand. Locally the two units interfinger with one another, and the contact between them represents a hydrologic boundary rather than a precise stratigraphic horizon (pl. 1).

The Jackson(?) Formation is composed of dark-gray to greenish-gray, dark-blue, or dark-brown clay. It is generally carbonaceous and contains very fine quartz sand along bedding planes. The formation is absent in southeastern Shelby County but is as much as 330 feet thick in the Parkway well field.

Fisk (1944, fig. 67, p. 62) distinguished a lower marine and an upper nonmarine facies in the Jackson(?) Formation. The marine facies closely follows the present course of the Mississippi River and extends northward at least 25 miles to Lauderdale County; there an exposure contains glauconite, foraminifera, shark teeth, and bones of sea animals. Fossil plants and leaves are abundant, and seams of lignite as much as 10 feet thick are common in the nonmarine facies.

TERRACE DEPOSITS AND ALLUVIUM

The terrace deposits ranges from a few feet to about 160 feet in thickness and are composed mostly of coarse-grained quartz sand and fine-grained iron-stained quartz and chert gravel. Thin lenses of silty ocher-colored clay are common in the lower part. The bottom 3 inches to 4 feet of sand and gravel generally is cemented with limonite. Although the contact with the Jackson(?) Formation represents an erosional surface, thin lenses of reworked Jackson(?) clay and sand form a transitional zone at the base of the terrace deposits in many places; geophysical logs show a gradation from one unit to the other.

The terrace deposits occur as an irregular belt parallel to the Mississippi River and also occur along the larger streams in the area. The deposits thin gradually eastward and are absent in many places as a result of erosion or nondeposition.

Two terraces were recognized by Glenn (1906, p. 41-44), who designated the higher as Pliocene and the lower as Pleistocene. Fisk

(1944, p. 63) considered them both to be of Pleistocene age. Because geophysical logs show no consistent correlation points, by means of which the terrace deposits can be divided in the subsurface, they are considered as a single unit in this report.

The alluvium ranges from 0 to 200 feet in thickness and is composed of sand, clay, silt, and gravel. It is confined to narrow strips along the principal streams and in most places is subject to flooding and reworking. The coarsest material is generally near the present stream channels, and the finest is near the featheredges of the deposits.

The alluvium is lithologically similar to the underlying terrace deposits, and the contact cannot be determined from geophysical logs. However, samples of the alluvium locally contain carbonaceous material and decaying vegetation which aid in distinguishing between the two units.

GEOLOGIC STRUCTURE

The Memphis area is near the axis of the Mississippi embayment syncline, which plunges southward at a rate of about 10 feet per mile in the vicinity of Memphis. The syncline began to form in Late Cretaceous time (Fisk, 1944, p. 8, 64; and Caplan, 1954, p. 5) as a result of regional subsidence centered along the present coast of the Gulf of Mexico. The axis of the structural trough approximately follows the present course of the Mississippi River.

As the region subsided, faulting of the unconsolidated sediments and the underlying Paleozoic rocks occurred, forming a rectangular pattern of faults and fractures trending northeast and northwest (Fisk, 1944, p. 64, 60). One of the major faults in this system, the Big Creek fault (Fisk, 1944, p. 66), trends northeast from near West Helena, Ark., along the western edge of the Memphis area to Reelfoot Lake near the Tennessee-Kentucky border; at Reelfoot Lake it appears to be related to the New Madrid (Missouri) fault system. This fault is of particular significance because it apparently restricts the movement of ground water from the west into the Memphis area.

A major fault is suggested by an abrupt bend in the Mississippi River near the mouth of Nonconnah Creek and by electrical logs of wells that indicate as much as 50 feet of displacement of geologic units in the Hickory Hill well field in the south-central part of the area. If such a fault exists, it has so far had little effect on the movement of water in the "500-foot" sand.

HYDROLOGY OF THE AQUIFER SYSTEMS

GEOLOGIC CONTROL OF GROUND WATER IN THE MEMPHIS AREA

The size, shape, and degree of interconnection of the open spaces between rock particles control the amount of water that can be cepted, stored, and eventually discharged to wells or by natural subsurface ground-water movement. In the Memphis area all ground water is obtained from unconsolidated deposits of sand and gravel.

Deposits of rounded well-sorted rock particles are the most permeable water-bearing materials because ground water can move freely through them toward pumping wells and into the aquifer in its recharge area. Mechanical analyses of sand samples from the "500-foot" and "1,400-foot" sands in the Memphis area show the sand particles to be well sorted but angular to subangular in shape. Although compaction and cementation affect the water-bearing properties of sand aquifers, these processes are of minor significance in the Memphis area, where cemented beds are rare and are seldom more than 1 foot thick. Faulting may also affect the ground-water conditions in an area by displacement of strata or by formation of a semi-impermeable barrier along the faulted zone. In the Memphis area the only structural deformation believed to affect ground-water movement is the previously described Big Creek fault, which restricts the inflow of ground water from the west. Relative positions of aquifers and confining clay beds also affect ground-water conditions in the Memphis area. In the outcrop area of the "500-foot" and "1,400-foot" sands east of Shelby County, water-table conditions exist. West of the outcrop, or recharge, area, however, confining beds of clay overlie the aquifers, and the water is under artesian pressure. As the water moves downdip in the westward dipping aquifers, the pressure surface becomes progressively higher above the confining clay beds which overlie the aquifers.

TEXTURE OF AQUIFER MATERIALS

More than 400 sand samples collected from many drilled wells in the Memphis area were analyzed to determine the distribution of particle size and the degree of sorting. These analyses give an indication of the hydraulic characteristics of the rocks because the size and sorting of the sand grains determine, to a great degree, the permeability and porosity. Coarse-grained sediments are less porous than fine-grained sediments; but because the pores are larger in the coarse-grained sediments, they are more permeable and will allow water to move through them more readily. Poorly sorted sediments are both less porous and less permeable than well-sorted sediments.

Comparison of one sample with another can best be made by comparing their respective sorting coefficients. The sorting coefficient is defined as the square root of the 25 percentile divided by the 75 percentile (Trask, 1932, p. 72). A value of 1 (unity) represents the highest possible degree of sorting. A sorting coefficient smaller than 2.5 indicates a well-sorted sample; 3, a normal sample; and 4.5 or

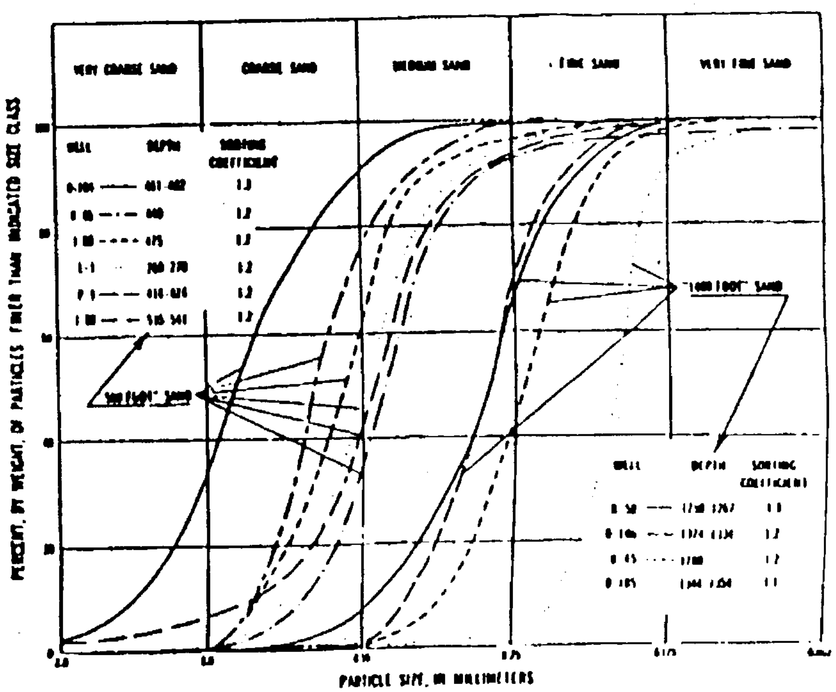
higher, a poorly sorted sample. Sorting coefficients of samples from both the "500-foot" and "1,400-foot" sands (fig. 4) range from 1.1 to 1.3. The steepness of the curves (fig. 4), also shows that the sand is well sorted.

The size-distribution curves also show that the grain size of material from the "1,400-foot" sand is fine to medium and that the grain size of material from the upper part of the "500-foot" sand is medium to coarse. Analyses of samples from the lower part of the "500-foot" sand are not shown in figure 4, but the particle-size distribution in the lower part is known to be similar to that in the "1,400-foot" sand.

In summary, particle-size distribution and sorting coefficient of aquifer materials are a measure of the aquifer's capability to transmit water to wells and therefore are useful in determining the best zone in the aquifer to be screened in a well and the type and opening size of screen to be used.

EFFECTS OF GROUND-WATER WITHDRAWAL

The most conspicuous effect of withdrawal of water from an aquifer is the decline of water level that causes a cone of depression to form in the water surface surrounding the point of withdrawal. The size of



the cone of depression formed by pumping a well or group of wells depends on the rate and amount of withdrawal and the hydraulic characteristics of the aquifer. Near the edge of the cone, the water-level depression or drawdown is small and, in effect, immeasurable because it is less than fluctuations caused by atmospheric-pressure changes and other influences. The theoretical distance to the edge of the cone of depression for a typical well field in the "500-foot" sand in the Memphis area pumping at an average rate of 10 mgd (million gallons per day) is about 5 miles from the center of withdrawal.

Increases in the annual rate of withdrawal have accelerated the lowering of the piezometric surface in the entire Memphis area so that the hydraulic gradient (slope of the water or pressure surface) is continually steeping. Consequently, larger amounts of water are transmitted into the area to supply the increased withdrawal. Figure 5 shows the Memphis municipal pumpage since 1898, and figure 6 shows the total municipal and industrial pumpage from the "500-foot" and the "1,400-foot" sands and the resulting water-level declines in the Memphis area from 1935 through 1960. As the rate of withdrawal increases, the regional cone of depression is expanded and deepened.

Under natural conditions, water was discharged from the "500-foot" and "1,400-foot" sands by subsurface flow to the west, thence southward along the axis of the embayment. Beginning with the first well drilled into the "500-foot" sand in 1886 (Lundie, 1898, p. 5-6), pumping has constantly increased, causing ground water to move into the enlarging cone of depression, thus eventually causing natural discharge as subsurface flow to stop.

THE "500-FOOT" SAND AQUIFER

DELINEATION

The "500-foot" sand in the Memphis area is delineated as a hydrologic unit although it includes all the deposits of the Claiborne Group. Geophysical logs of wells were used to identify the top and bottom of the aquifer as limited by the overlying and underlying confining clay. Most of the logs show distinct differences between the aquifer and the confining clay beds; however some show gradational changes from predominantly clay to predominantly sand beds. In the absence of a distinct and abrupt sand-clay contact, the boundary is selected arbitrarily at the middle of the transition zone in order to determine the average thickness of the aquifer. Delineated on this basis, the aquifer also may include some sandy beds of the lower part of the Jackson (?) Formation. In some parts of the area the Jackson (?) is not present.

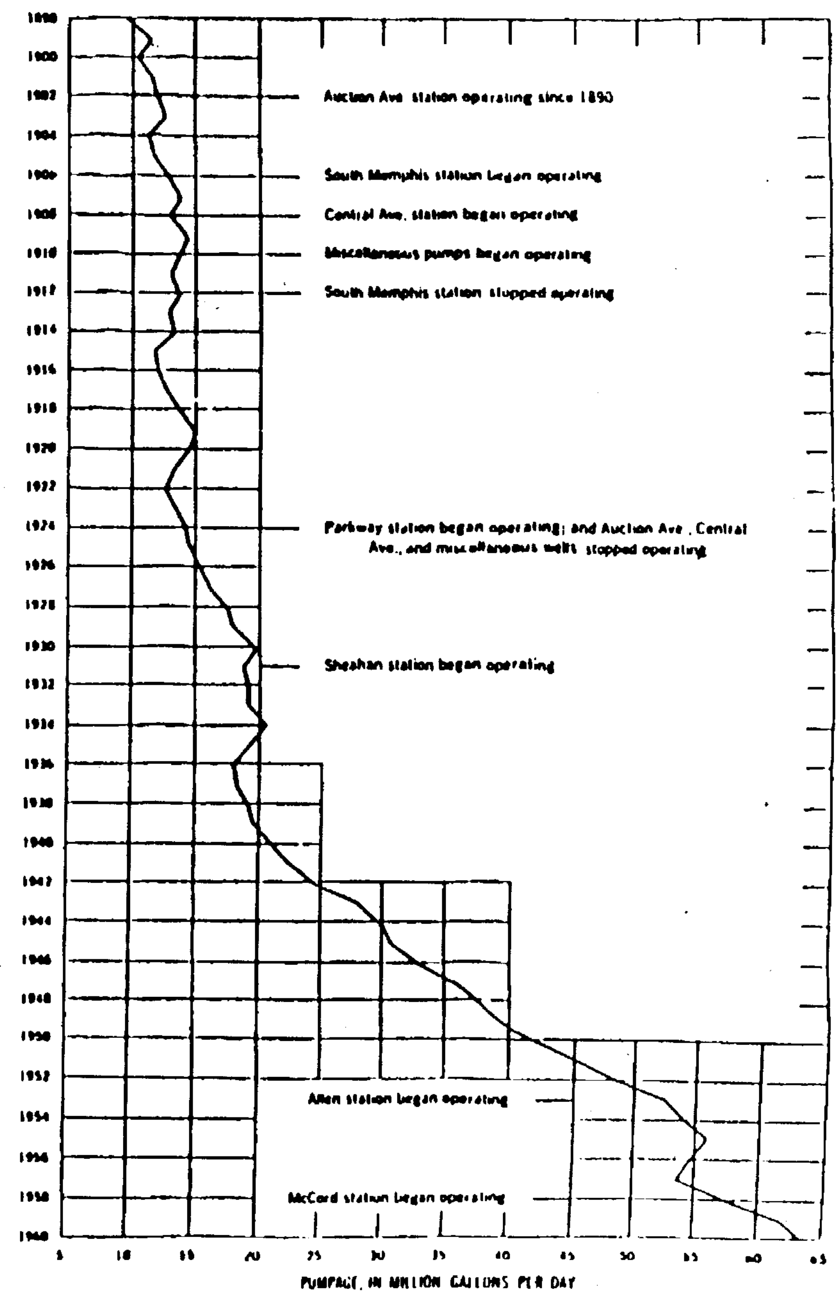


FIGURE 5.—Memphis municipal pumpage, 1898-1960.

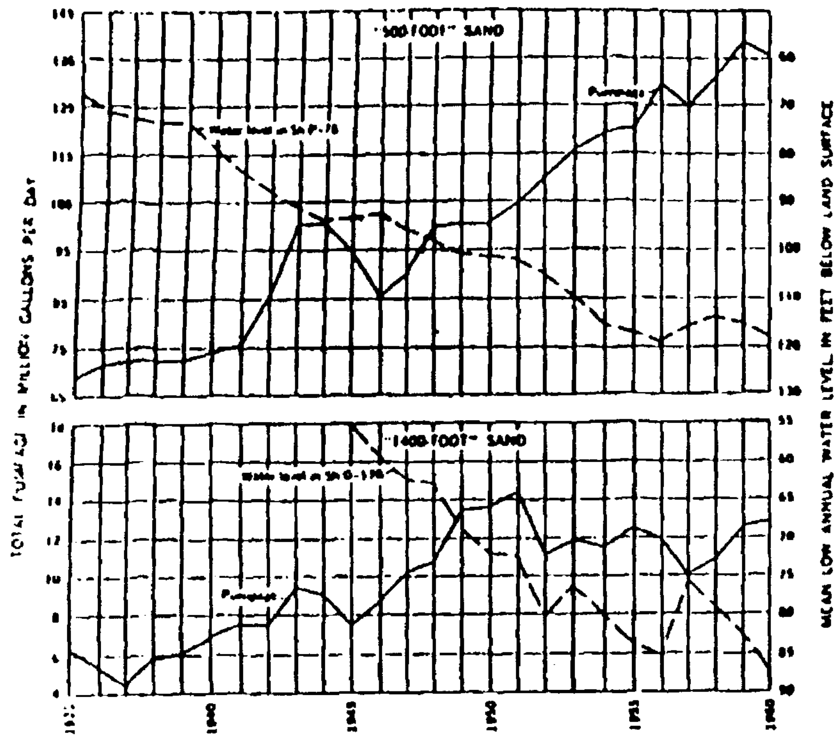


FIGURE 8.—Relation between total pumpage from the "500-foot" and "1,400-foot" sands and water-level declines in the Memphis area, 1935–60.

posed of coarse sand and gravel. These deposits are hydrologically connected with the "500-foot" sand in such areas but are not considered a part of the aquifer.

Plates 2 and 3 show the elevation and configuration of the top and bottom, respectively, of the "500-foot" sand in the Memphis area. These maps and the geologic section (pl. 1) show that the "500-foot" sand ranges from 500 to 800 feet in thickness, averaging about 700 feet thick, and dips toward the northwest at a rate of about 13 feet per mile. The volume of the aquifer, calculated from the contour maps, is about 25 trillion (25×10^{12}) cubic feet in the 1,300 square mile area shown in plates 2 and 3.

WATER LEVELS

DECLINE CAUSED BY PUMPING

Ground-water withdrawal from the "500-foot" sand for municipal and industrial use in the Memphis area has increased from about 68 mgd in 1935, the first year for which records are available, to about 135 mgd in 1960. This withdrawal, which averages about 100 mgd for the

period, has formed a major cone of depression under the city of Memphis, where most of the pumping is concentrated, and has formed smaller superimposed cones under the Parkway, Allen, and Sheahan well fields (pl. 4). The regional relation between ground-water withdrawal and water-level decline in the "500-foot" sand is best illustrated by the hydrograph of well Sh: P-76 (fig. 7). This well is in the center of the major or regional cone of depression and is approximately equidistant from the smaller superimposed cones of depression caused by pumping in the Parkway, Allen, and Sheahan well fields. During 1935–60 an average rate of withdrawal of about 100 mgd resulted in a water-level decline of about 50 feet in well Sh: P-76, or about one-half foot decline for each million gallons pumped per day. Figure 8 shows progressively smaller declines in well Sh: O-1, 8 miles north of the center of pumping, and in well Sh: Q-1, 10 miles east of the center of pumping. Figure 9 shows still smaller declines in wells Sh: U-2, 15 miles north, and Fa: W-2 (Fayette County), 30 miles northeast of the center of heavy pumping.

The rate of water-level decline has increased since the early 1950's, at which time the rate of pumping increased to an average of about 120 mgd (1950–60) compared with an average of about 90 mgd for the preceding period (1935–50). The maximum decline for the period 1950–60 is about 47 feet in the Allen well field (pl. 5), which was placed in operation in early 1953. About 75 percent of this decline occurred in the first year of operation of this field. Smaller declines occurred in the Parkway and Sheahan well fields (pl. 5) during this period because these fields have been in operation since 1924 and 1931, respectively (fig. 5), and the rates of decline in each have decreased as their cones of depression have expanded and established a stable hydraulic gradient. The 24-foot decline in the McCord well field occurred after early 1958, when the field began operation. As in the Allen well field, the rate of decline in the early years of operation is greater than that in subsequent years, provided the rate of ground-water withdrawal remains the same.

Prior to 1958, when the McCord well field began operation, water levels in the field declined slowly and steadily (fig. 10) as a result of overall pumpage in the Memphis area. In 1958, the water level in an observation well near the McCord well field (fig. 10) declined about 18 feet for an average pumping rate of 12.5 mgd. Thus the relation between the water-level decline in this observation well and the pumpage of the well field was about 1.5 feet for each 1 mgd pumped. The next pronounced change in the rate of pumping occurred during the summer of 1960 when, between June and August, the pumping rate decreased from about 11.5 to 7.5 mgd. The water level in wells near

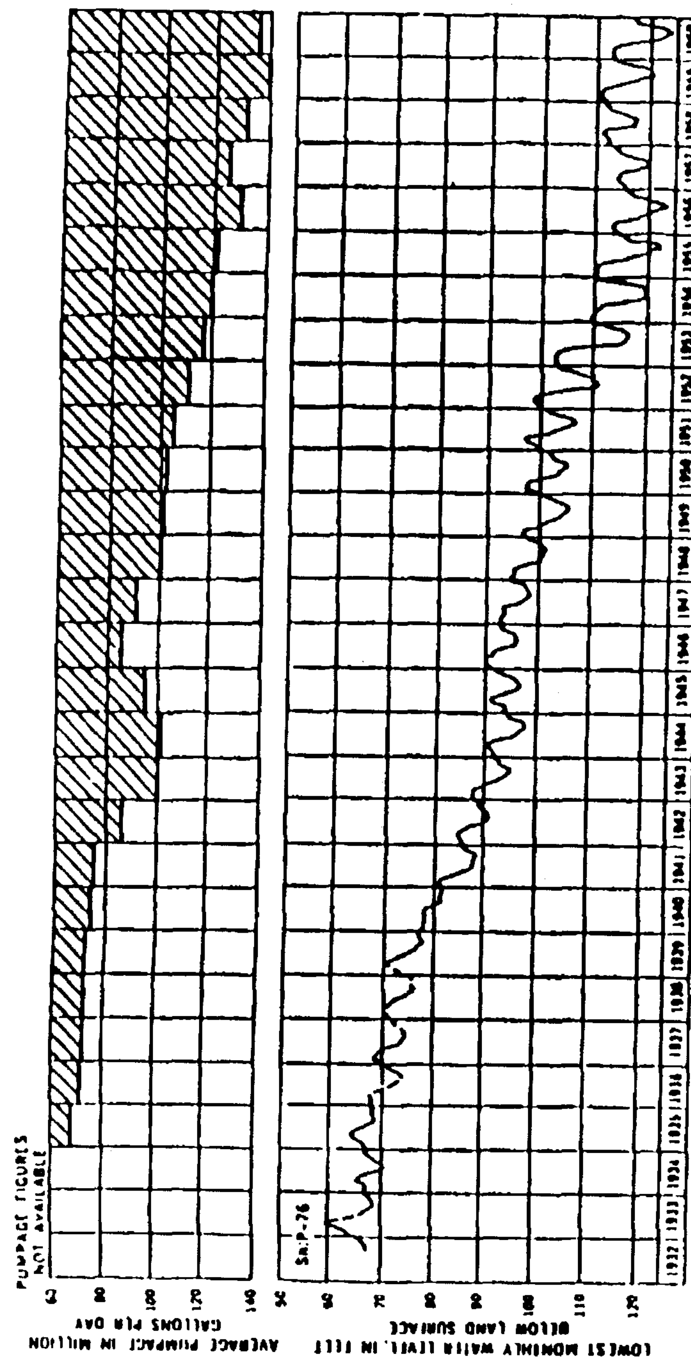


FIGURE 7.—Relation between ground-water withdrawal from the "500-foot" sand and water-level decline in the center of concentrated pumping.

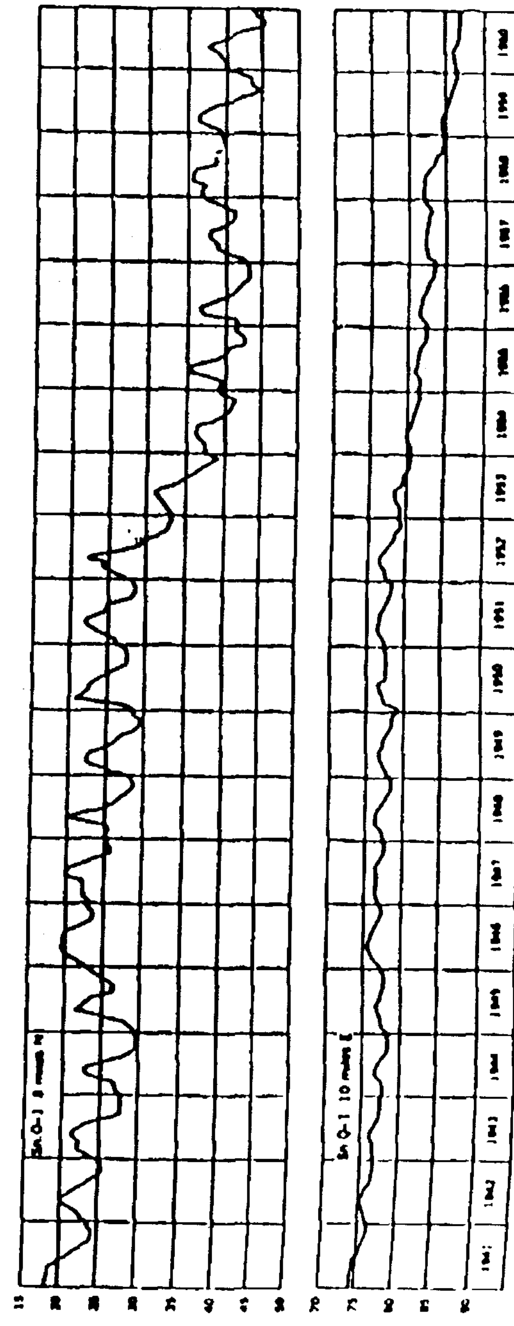


FIGURE 8.—Declines of water level in the "500-foot" sand, 8 and 10 miles from the center of concentrated pumping in the Memphis area.

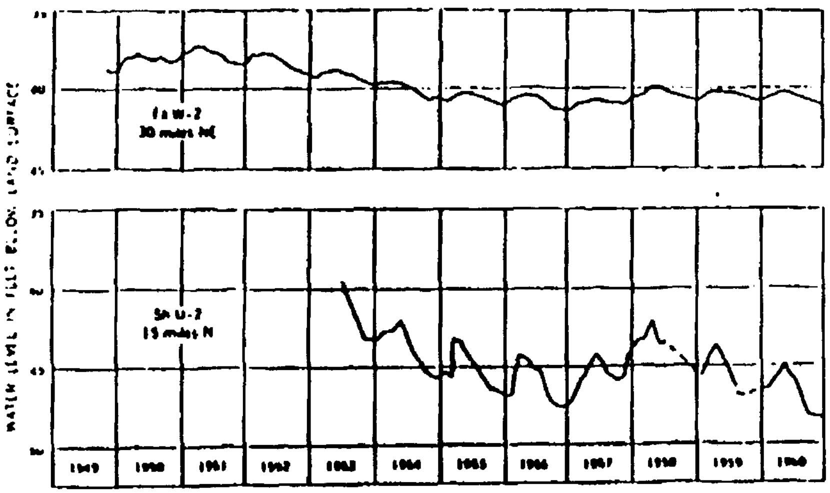


FIGURE 9.—Declines of water level in the "500-foot" sand, 15 and 30 miles from the center of concentrated pumping in the Memphis area.

the well field rose about 4 feet. Normally during this part of the year, the water level declines about 2 feet. Therefore, the effective recovery resulting from the pumpage reduction was about 6 feet. This again indicates a ratio between water-level rise or decline in the selected observation wells and pumpage of about 1.5 feet for each 1 mgd change in rate of pumping. Similiar determinations for the Allen (fig. 11) and Sheahan (fig. 12) well fields indicate ratios of 1.1 to 1 and 1.5 to 1 (feet of decline or rise to each million gallons per day increase or decrease in pumping) for these fields, respectively. The production ratio for the Allen well field is less because pumping has not continued long enough for the piezometric surface to stabilize in this newer well field. The production ratio for all well fields in the area should increase as water levels decline toward more stable pumping levels.

The distribution of production wells in the Parkway well field with respect to observation wells make it impossible to show a consistent relationship between the water level and the pumpage in this well field (fig. 13). The fluctuations resulting from seasonal and intermittent pumping are the only discernible parts of water-level changes. Figure 13 shows that a reduction of pumpage during 1945–49 did not cause a rise of water level in observation well Sh:O-153. This well is in the eastern part of the well field where the pumping rate was increased to offset the reduction in pumping in the western part of the well field. However, records of short-term observation wells indicate that the relation between water level and pumping differs little from that of

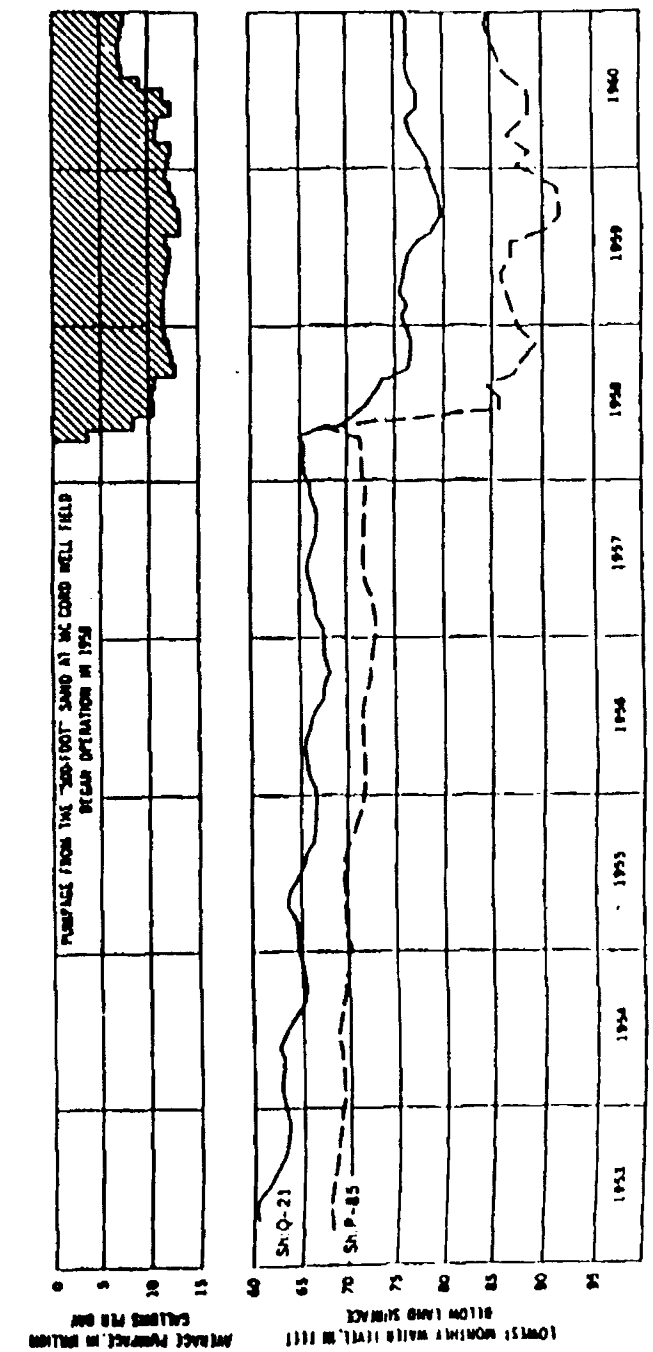


FIGURE 10.—The relation between pumping and water level ("500-foot" sand) in the McCord well field, Memphis, Tenn.

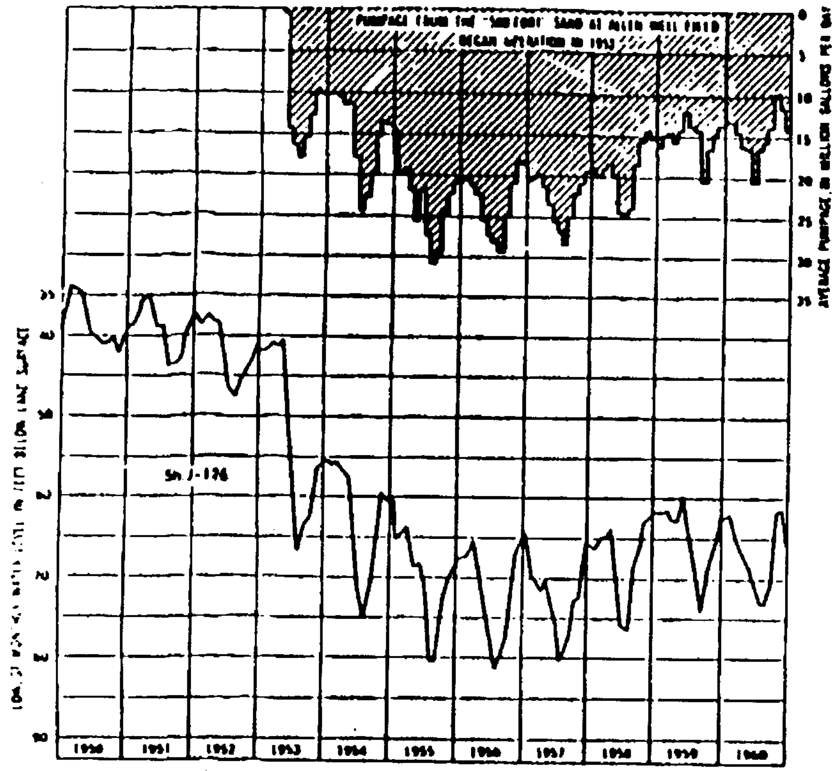


FIGURE 11.—The relation between pumping and water level ("500-foot" sand) in the Allen well field, Memphis, Tenn.

The hydrographs from observation wells equipped with recording gages generally show that those wells within or near the area of greatest withdrawal have their lowest water level in August each year, reflecting the highest monthly rate of withdrawal. Figures 7–9 show the declining trend of water level in the "500-foot" sand at various distances from the center of pumping as well as the annual low water level. The lowest annual water level occurs progressively later in observation wells that are farther from the center of pumping. The greater the distance, the greater the lag in the time of arrival of the effect of pumping. The lowest annual water level in observation well Fa: W-2 (fig. 9), which is 30 miles from the theoretical center of pumping, occurs in late December or early January, or about 4 months after the annual low water level in Memphis. The effect of cyclical pumping in the Memphis area, where the pumping is greater in summer than winter, is a wavelike motion of alternate low and high water levels traveling outward at a decreasing rate from the center of pump-

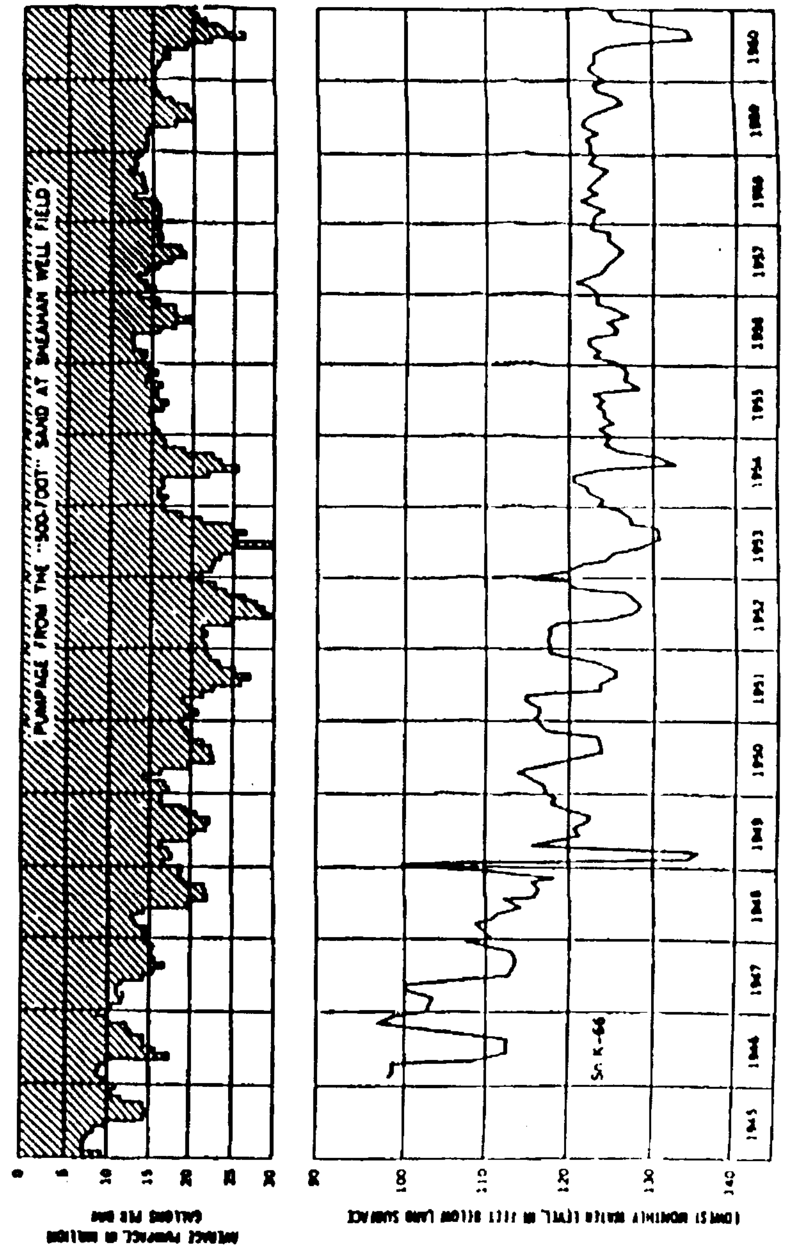


FIGURE 12.—The relation between pumping and water level ("500-foot" sand) in the Sheahan well field, Memphis, Tenn.

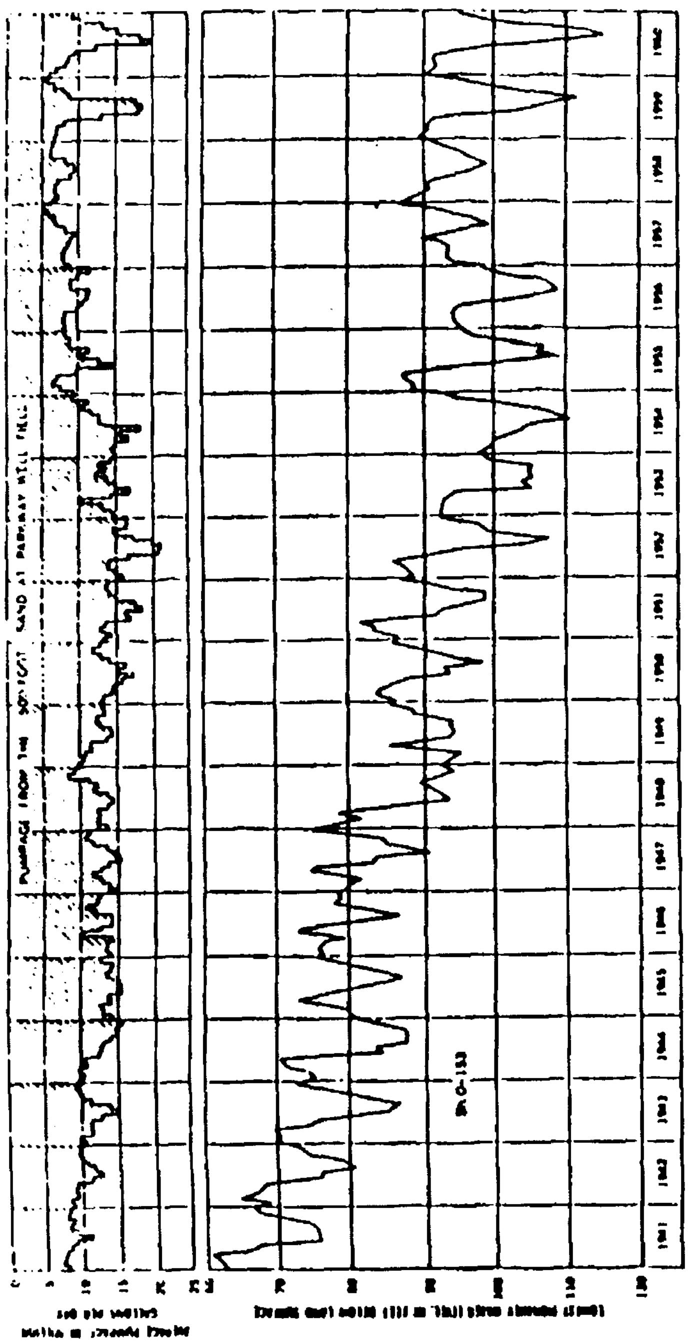


FIGURE 13.—The relation between pumping and water level ("500-foot" sand) in the Parkway well field, Memphis, Tenn.

bination of several factors including the degree of confinement, elasticity, and transmissibility of the aquifer. This effect should be considered when proposing locations of future well fields so that advantage can be made of the time lag of arrival of low water level. In a practical example, a typical well field about 20 miles from Memphis would be pumping at its lowest seasonal rate at a time when water levels are lowest and pumping most water at the time when water levels are highest.

Hydrographs of observation wells in the "500-foot" sand (figs. 7-9) indicate that the annual decline of the piezometric surface can be reasonably estimated for given rates of pumping. These figures show the fluctuations and general decline of water level in the Memphis area near the center of pumping (fig. 7), about 8 and 10 miles from the center of pumping (fig. 8), and 15 and 30 miles from the center of pumping (fig. 9). The theoretical center of pumping in the area is about the location of observation well Sh: P-76 (pls. 4, 6). Figure 9 shows that the seasonal fluctuation of water level in well Fa: W-2 about 30 miles northeast of Memphis in Fayette County is nearly 1 foot. The overall water-level trend is a declining one, although there are short periods of a rising water level caused by reductions in pumping rate, recharge to the aquifer, or both. This observation-well record reflects the regional water-level fluctuations and is less affected by small changes in pumping in Memphis. The seasonal range of water-level fluctuation in well Sh: U-2 in Memphis (fig. 9) has been about 3.5 feet except in 1957, a year of record-high rainfall. The record of this well also indicates the regional water-level trend, but the effect of changes in pumping in Memphis is more pronounced in this record than in that of well Fa: W-2.

FLUCTUATION

Precipitation causes water-level fluctuations in wells by recharging the aquifer in its outcrop area, by seeping through the overlying clays where they are thin or missing, and, to a minor extent, by loading. The effect of recharge to the aquifer caused by unusually high precipitation is illustrated in the hydrograph of well Fa: W-2 for 1957 (fig. 9). The water level in this well under normal conditions of rainfall and pumping in the Memphis area would have declined about 0.3 foot in 1957. Instead, the water level rose about 0.8 foot, an effective change of 1.1 feet. Past records indicate that a reduction of pumpage of 10-20 mgd in Memphis would have been required to cause a 1.1-foot change in water level in this observation well. The annual average daily pumpage in 1957 was only about 1 mgd less than in the previous year. Therefore, the rise of water level in 1957 was largely due to recharge from heavy rainfall in the outcrop area of the "500-foot" sand.

Loading of an aquifer, as by passing railroad trains and by rainfall, may also cause water-level fluctuations; but for a specific load the net water-level change is zero, and no rising or declining trend results. Generally, the water level rises as a load is applied then decreases rapidly even though the load may remain. Wells (1931, p. 25) believed that the Mississippi River added water to the "500-foot" sand, because a series of water-level measurments in wells along the river were higher when the river was high. Data collected by Kazmann (oral communication, 1954), however, indicated that loading of the aquifer by the weight of rapidly rising water in the river caused the water level also to rise in certain wells. In agreement with Kazmann's conclusion, it is doubtful that the river would have furnished water to the aquifer even if there had been a hydraulic connection between the river and the aquifer, because at that time (1931) the water level in the aquifer was about as high as the level of the river.

Atmospheric-pressure fluctuations may cause as much as a foot of change in water-level, depending partly on the rapidity of the change in pressure. These are basically daily-cycle fluctuations and are considered only during strict aquifer performance tests when water-level measurements are corrected for barometric effect. Within a short time the pressure-influenced water level regains its original level, often with the assistance of a reverse change in atmospheric pressure. The net change in water level resulting from atmospheric pressure change is zero over a period of time, generally 1 day.

HYDRAULIC CHARACTERISTICS

The amount of water that can be pumped from an aquifer perennially depends primarily on the capacity of the aquifer to transmit water from areas of recharge to areas of discharge, the amount of water available for recharge, and the amount of water in storage in the aquifer. To estimate the amount of water that can be pumped perennially with proper accuracy, the hydraulic characteristics of the aquifer must be known. Aquifer performance or pumping tests are the most economical method of determining the hydraulic characteristics. These characteristics are permeability (P), transmissibility (T), and storage (S). These and other terms used to describe the hydrologic properties of rocks were defined by Meinzer (1923), Wenzel (1942), and Ferris and others (1962).

Pumping tests consist of observing the rate of drawdown in observation wells for a given uniform rate of pumping in a nearby well or of observing the rate of water level recovery in a pumped well, or observation wells, after pumping stops. Pumping-test data were analyzed by standard methods, and the results were approximately the

same as the values of the hydraulic characteristics. For this reason the less laborious semilog-plot method is used in this report.

Figure 14 shows a semilog plot and sample analysis of pumping-test

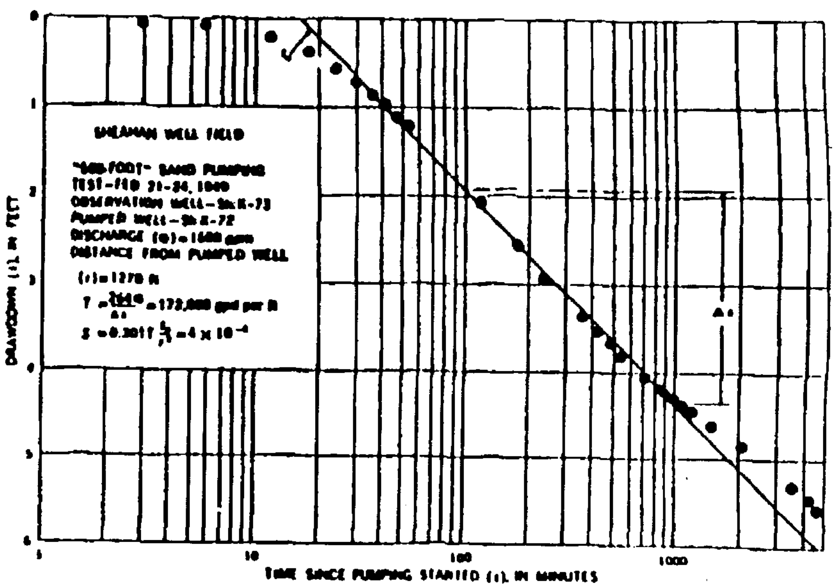


FIGURE 14.—Sample computations of transmissibility and storage coefficients for the "500-foot" sand using plotted pumping-test data.

data from wells in the "500-foot" sand. The figure also shows the procedure for computing the hydraulic characteristics of the aquifer.

The numerical values of hydraulic characteristics determined by pumping tests reflect the effects of all material within the zone of influence of pumping in the aquifer. This zone extends horizontally to the perimeter of the cone of depression of the pumping well. Its vertical influence may not extend to the bottom of the aquifer because of the anisotropy of the formation and partial penetration of the wells. As a result, a single pumping test provides hydraulic constants determined by the part of the aquifer affected during the test. These values are adequate for predicting aquifer response for that particular affected area under conditions generally the same as those prevailing during the period of the test. The values of the hydraulic characteristics of the total volume of the aquifer were determined by averaging the results of all tests and adjusting them for partial penetration of wells and other factors.

The wells that were used in all tests of the "500-foot" sand in the Memphis area are less than 500 feet deep and penetrate from 5 to 15 percent of the total thickness of the aquifer. Local clay lenses are present in above and (or) below the screens of some wells. The wells range in diameter from 4 to 20 inches; well screens range in diameter from 3 to 12 inches and in length from 10 to 120 feet.

Specific capacity of wells ranges from 10 to 100 gpm per foot of drawdown. The coefficient of transmissibility determined by analyses of data from these tests ranged from 100,000 to 410,000 gpd per ft, and the coefficient of storage from 1×10^{-4} to 3×10^{-3}. The average adjusted coefficients of the "500-foot" sand for the total thickness of the aquifer throughout the entire area are about 400,000 gpd per ft and 3×10^{-4} for T and S, respectively. Average values are used in this report to make quantitive determinations, and these values will be adequate for future determinations where artesian conditions prevail.

RECHARGE AND MOVEMENT

Recharge to the "500-foot" sand aquifer generally occurs in the areas where it lies at or near the land surface. Percolation of rainfall directly through the sandy soil in the outcrop area and seepage from streams recharge the aquifer where it crops out in the rolling hills 30–60 miles east of Memphis. The annual precipitation at Moscow and Bolivar, Tenn., in the recharge area, is slightly greater than at Memphis (fig. 2), and rainfall is fairly well distributed throughout the year.

In addition to recharge in the outcrop area, the "500-foot" sand locally receives some water from the overlying terrace deposits where ever the clay bed that generally underlies the terrace deposits is sandy or thin and where streams have cut deeply into the clay bed. Nonconnah Creek, formerly a perennial stream, now has periods of abnormally low flow in its lower reach during part of the year and has been dry during the latter part of the dry season in recent years. This change in its regimen is attributed to increased recharge to the "500-foot" sand as a result of the decline of water level in the aquifer within the past few years. Recharge to the aquifer probably is increasing as the effect of pumping in the Memphis area spreads to the outcrop area and areas where seepage can occur.

The rate of water movement depends on the transmissibility of the aquifer and the hydraulic gradient. In general, the greater the rate of discharge, the more rapid the movement of water through the aquifer along the flow path. However, limitations on the maximum possible rate of movement are determined by the aquifer characteristics, not by the rate of discharge.

The movement of water in the Memphis area before development of the "500-foot" sand began was probably along the dip of the formation ... and regionally southward down the

lic gradient between Collierville and Memphis was about 5×10^{-4} in 1886. Using this value for the hydraulic gradient and an average transmissibility of 4×10^{5} gpd per ft for the "500-foot" sand aquifer, about 1 million gallons of water moved across each 1-mile section of the aquifer each day in 1886. The eastern boundary of the area is about 30 miles in length; therefore, the average rate of water entering the Memphis area in 1886 was about 30 mgd. If we assume that stable conditions existed at that time, the rate of natural discharge was equal to the recharge rate.

The present direction of movement of ground water in the Memphis area is generally toward central Memphis from all directions as shown on plate 4. Water-level contours (pl. 4) indicate that more water is derived from the east-southeast; probably because transmissibility is greater in that part of the area, the dip of the "500-foot" sand is toward the northwest (figs. 5, 6), and the nearest area of recharge lies to the southeast. The amount of water moving across the 260-foot contour on plate 4 is about 60 mgd. Total inflow is tabulated in the section on pumping.

The amount of water moving into the area from the west is small, probably because the Big Creek fault forms a hydraulic boundary restricting inflow. Further increases in pumping in the Memphis area will produce steeper gradients and induce a greater amount of water to flow toward the centers of pumping.

The present rate of movement of ground water in the "500-foot" sand in the southeastern part of the area is estimated to be approximately 70 feet per year toward the west-northwest under a hydraulic gradient of about 5 feet per mile (9×10^{-4}). At the edge of the area of heavy withdrawal, approximately 3 miles from the present city limits (pl. 3), the gradient steepens to about 10 feet per mile and the rate of ground-water movement increases accordingly to about 140 feet per year. In and near the well fields, the velocity of flow is even greater. In the northeastern part of the area, the hydraulic gradient is about 3 feet per mile, and the rate of movement about 40 feet per year.

PUMPING

An average of about 135 mgd was pumped from the "500-foot" sand in 1960. A little less than half this amount was for municipal use, and a little more than half was for industrial use. Pumping records reported monthly to U.S. Geological Survey indicate that industrial pumping is nearly constant and that municipal pumping may vary as much as 100 percent from summer to winter. Figure 6 shows the average daily pumping rate for each year since 1935. The effect of

As previously stated, the natural discharge moving out of the Memphis area toward the west and thence southward along the axis of the embayment was about 30 mgd in 1886. Natural discharge probably ceased when the water level was lowered to about 200 feet above mean sea level in central Memphis. The hydraulic gradient created by pumping in Memphis probably was sufficient to stop the natural discharge from the area by 1940.

The total amount of water pumped from the "500-foot" aquifer between 1886 and 1960 is estimated to be about 1.9 trillion gallons (1.9×10^{12}). If it is assumed that $S=3\times10^{-4}$ and that the water level declined 60 feet between 1886 and 1960, then the total amount of water pumped from storage is about 12 billion gallons. This quantity is less than 1 percent of the total pumpage since 1886—that is, an average of about 1 percent of the water pumped each year was derived through depletion of storage in the aquifer.

A water-control budget for the "500-foot" sand aquifer was computed using the low-water-level contours for 1960 (pl. 4) and checked against the average daily pumping rate for 1960. Inflow into the Memphis area was determined to be generally as follows:

Inflow	Million gallons per day
Across eastern boundary	60
Across northern boundary	20
Across southern boundary	25
Across western boundary [1]	29
Depletion of storage	1
Total	135
Average daily pumping rate for 1960	135

[1] Includes leakage from rocks above aquifer and inflow of water from other sources.

THE "1,400-FOOT" SAND AQUIFER

DELINEATION

Delineation of the "1,400-foot" sand in the Memphis area is based on the same hydrologic considerations as is delineation of the "500-foot" sand. The upper and lower boundaries (pls. 6, 7) were determined primarily by interpretation of electric and gamma-ray logs which show distinct contacts (pl. 1) of the sand with its confining clay formations. The confining clay formations are thick and for practical purposes may be considered impermeable. The aquifer is continuous throughout the area and dips toward the west at a rate of about 25 feet per mile. The sand probably crops out 60–80 miles east of Memphis although in some

ship, 1950). The thickness of the aquifer increases from about 150 feet in the eastern part of the Memphis area to about 300 feet in the western part. The volume of the aquifer in the 1,300 square mile area is about 7 trillion cubic feet (7×10^{12}).

WATER LEVELS

DECLINE CAUSED BY PUMPING

The relation between water-level fluctuations and pumping in municipal well fields is shown in figures 15 and 16. The two observation wells represented are in the Parkway and Sheahan well fields and clearly show the effect of changes in pumping rates, although the water-level fluctuations cannot be correlated quantitatively with the pumping from each well field because fluctuations caused by natural phenomena obscure the fluctuations caused by pumping. These two municipal well fields and one industrial plant well field are the only ones in Shelby County having one or more wells screened in the "1,400-foot" sand. Nearly all the observation wells are close to production wells in these fields, and intermittent pumping of the production wells often masks any areal water-level trend that might be noted in an observation well several hundred feet from a well field.

The water-level fluctuations in observation wells at greater distances from the areas of heavy withdrawal (fig. 17) are less pronounced, and the hydrographs of these wells reflect regional trends of water level.

The hydrographs in figure 17 show that, except for during 1957 and 1958, the average seasonal fluctuation in well Fa: W-1, about 30 miles northeast of Memphis, is about 1.2 feet; and in well Sh: U-1, about 15 miles north of Memphis, it is about 3.5 feet, or about three times that in well Fa: W-1. The ratio of the logarithms of the two distances mentioned above is also 3, so that a rule can be inferred as follows, relating distance to seasonal fluctuations:

$$\frac{\log 30}{\log 15}\times\text{seasonal fluctuation at 30 miles}=\text{seasonal fluctuation at 15 miles.}$$

This may be a general rule for predicting water-level fluctuations and decline in the Memphis area and possibly other similar areas where no observation wells exist, but it has not been proven.

In wells in the "1,400-foot" sand, water levels declined at an almost constant rate until 1952 as a result of gradual increases in pumping. In 1952 pumping was decreased (fig. 17). However, the trend of decline continued (fig. 17) until 1957 because drought conditions in the outcrop or recharge area of the aquifer prevented immediate replenishment of the water pumped from the Memphis area. Since 1957 the water level has remained about constant. No significant

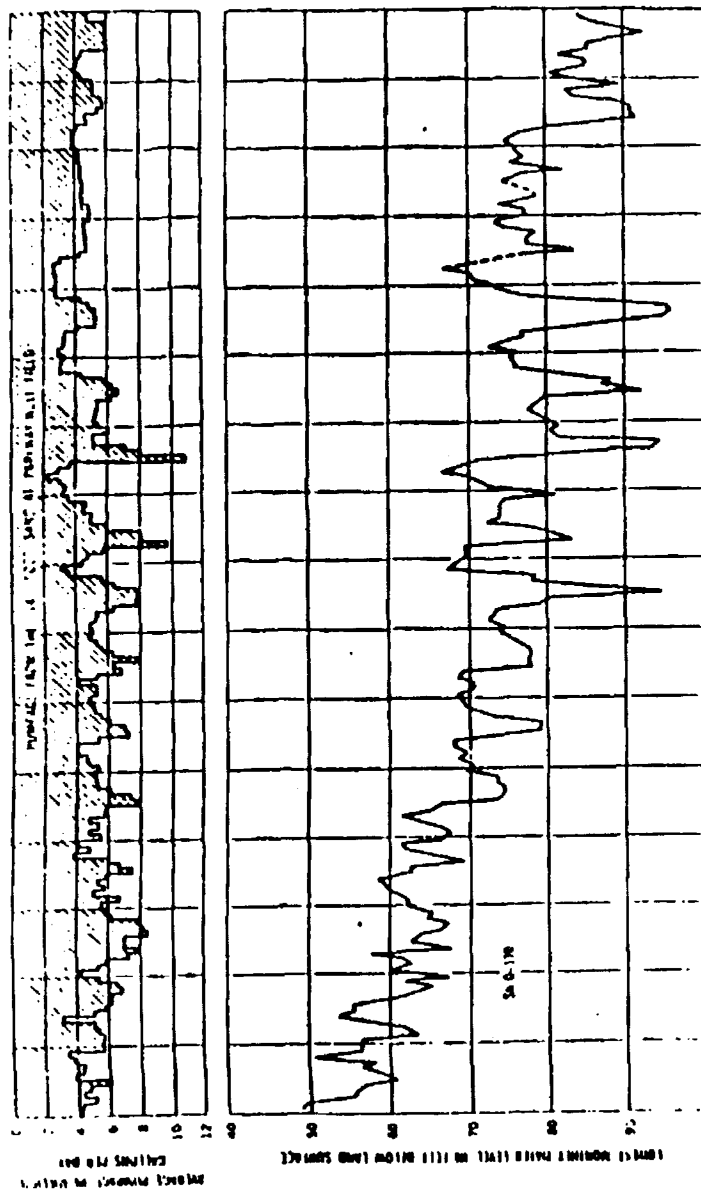


FIGURE 15.—The relation between pumping and water level ("1,400-foot" sand) in the Parkway well field, Memphis, Tenn.

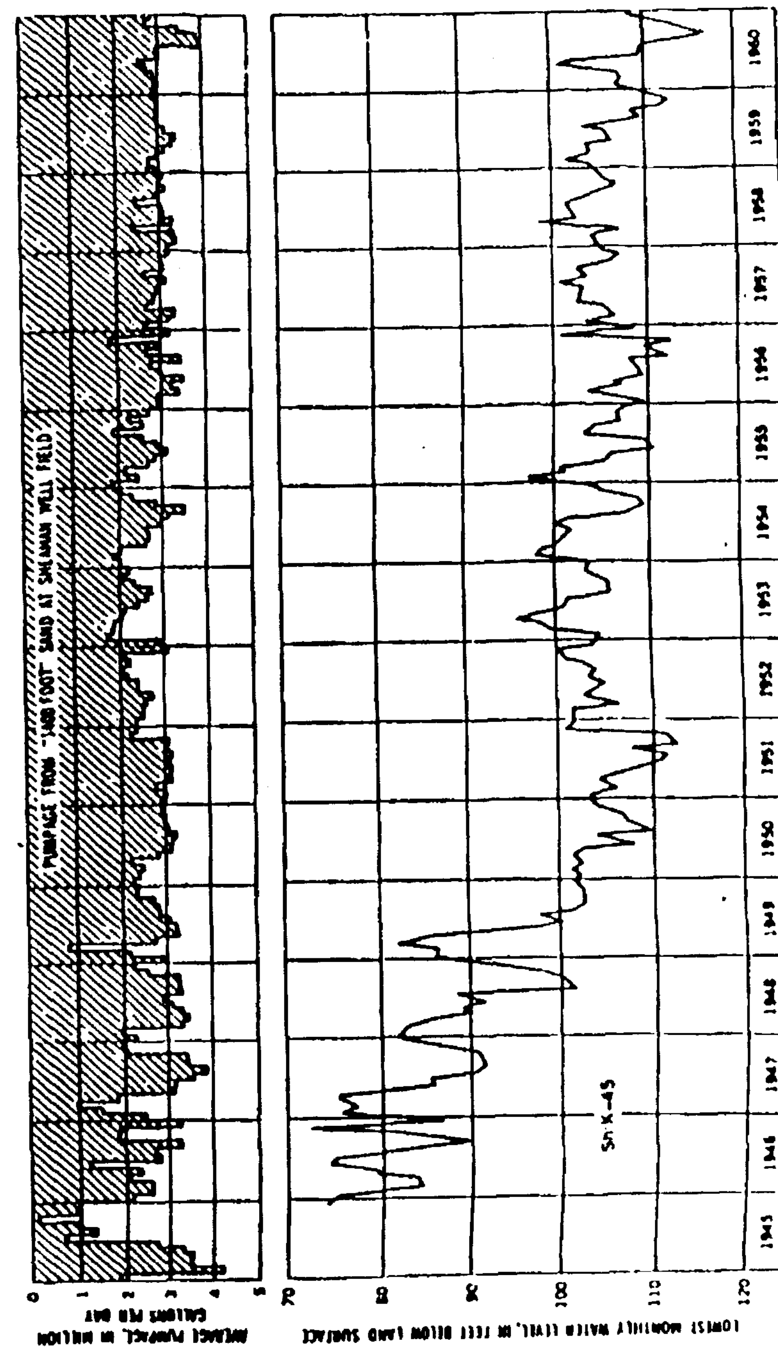


FIGURE 16.—The relation between pumping and water level ("1,400-foot" sand) in the Sheahan well field, Memphis, Tenn.

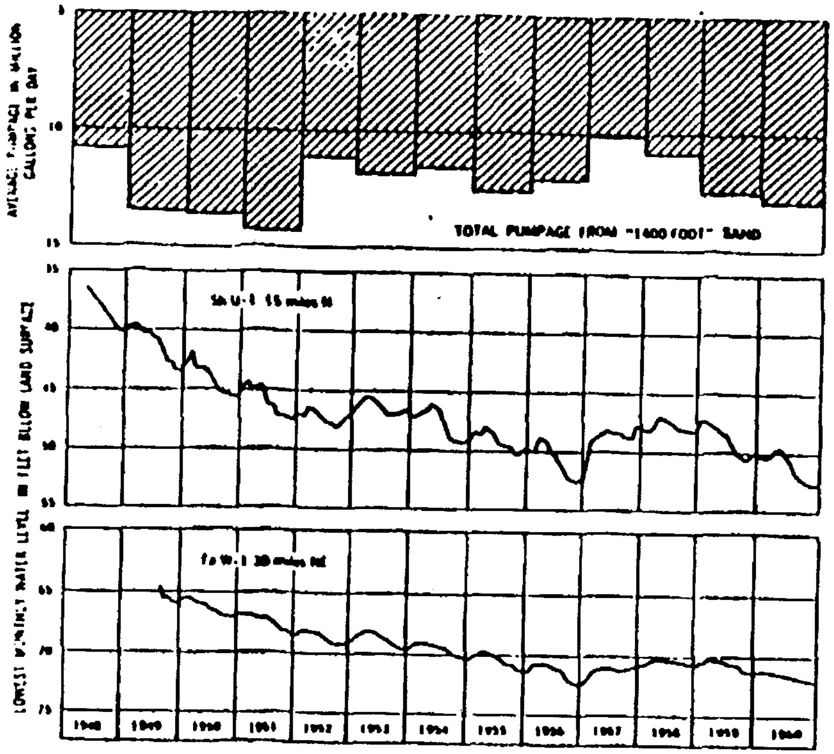


FIGURE 17.—The relation between total pumpage from the "1,400-foot" sand in the Memphis area and water levels in wells Sh: U-2 and Fa: W-1, 15 and 30 miles, respectively, from the center of pumping.

FLUCTUATION

Water levels in the "1,400-foot" sand fluctuate in response to the same causes discussed earlier for the "500-foot" sand. Fluctuations resulting from atmospheric-pressure changes are slightly more pronounced because the aquifer is under higher artesian pressure and its barometric efficiency is greater. Water level fluctuations resulting from loading are negligible because of the structural support of the greater thickness of material above the aquifer.

Since 1957, water levels have fluctuated primarily in response to rainfall in the outcrop area of the "1,400-foot" sand aquifer. Hydrographs (fig. 17) show that water levels rose from 1957 to 1959 during a period of normal to above normal precipitation even though pumping increased slightly over the same period. The regional rise of water level is similar to the rise of water level in the "500-foot" sand (fig. 9) during the same period.

HYDRAULIC CHARACTERISTICS

The numerical values of the hydraulic characteristics of the "1,400-foot" sand determined from seven tests in the three well fields in Memphis cover a rather narrow range.

	Average	Minimum	Maximum
T	3×10^{-4}	90,000	140,000
S	3×10^{-4}	1.5×10^{-4}	4×10^{-4}

An example of test data is shown in figure 18. The highest values of the coefficients were from tests at the Parkway well field (pl. 6), where the thickness of the "1,400-foot" sand is about 15 percent greater than in the other well fields.

The yields of the wells used in the tests ranged from 400 to 1,600 gpm (gallons per minute). The wells range in diameter from 8 to 24 inches. The well screens are 8–10 inches in diameter, 55–120 feet in length, and penetrate less than 50 percent of the thickness of the aquifer.

The aquifer-test results indicate that the "1,400-foot" sand is almost an ideal artesian aquifer. The changes of water level in observation wells in response to changes in the rate of withdrawal were almost instantaneous, indicating near-perfect vertical confinement between the clay boundaries. The barometric efficiency of the aquifer ranged from 75 to more than 95 percent, also indicating near perfect confinement.

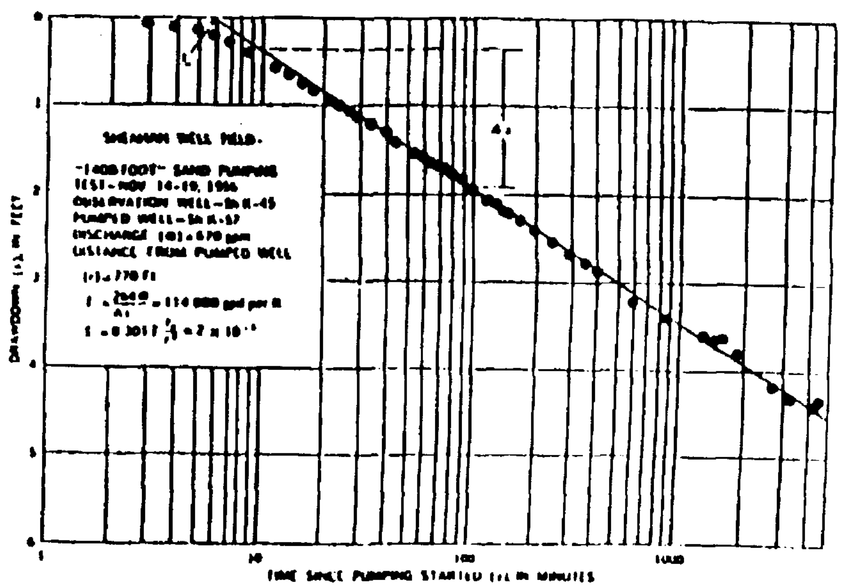


FIGURE 18.—Sample computations of transmissibility and storage coefficients for the [illegible]

Tests made in the same well fields in 1944 and later show that the hydraulic characteristics of the aquifer have not changed appreciably in about 15 years.

The hydraulic constants determined for the "1,400-foot" sand are more reliable than those for the "500-foot" sand, and the constants may be used more etxensively because the "1,400-foot" sand is more uniform in texture and thickness.

RECHARGE AND MOVEMENT

In some part of the outcrop area where the "1,400-foot" sand is in contact with the bottom of the "500-foot" sand, the "500-foot" sand outcrop serves as the recharge area for both aquifers (Schneider and Blankenship, 1950, chart 1). Where the sand is exposed at the surface, it receives recharge from precipitation and from seepage from streams. The rate of recharge is influenced by the rate and amount of precipitation, as indicated by hydrographs of wells in the "1,400-foot" sand (fig. 17) which show that the water levels rose in 1957, a year of unusually high rainfall.

The rate of recharge before the development of wells in the aquifer began, based on available data and the assumption that recharge was equal to the natural discharge at that time was about 5 mgd to the Memphis area. The present rate of recharge is unknown but is less than the pumping rate for the area.

The amount of water moving toward a well is proportional to the hydraulic gradient of the cone of depression. Generally, the hydraulic gradient increases as the rate of pumping increases. If the pumping rate remains constant, the cone of depression expands and the hydraulic gradient tends to flatten, other factors being equal, until an equilibrium slope is established. The 1960 rate of withdrawal from the "1,400-foot" sand was about 13 mgd, and this quantity has not varied more than 20 percent during the past decade. The hydrographs of wells Fa: W−1 and Sh: U−1 (fig. 17) show that the hydraulic gradient established in the "1,400-foot" sand has flattened and remained about constant several miles from the area of heavy withdrawal for the past decade also. The gradient 15–30 miles from central Memphis is about 3 feet per mile (or 5.7×10^{-4}), and the rate of movement of water is about 40–50 feet per year.

Water-level data for 1924 (Schneider and Cushing, 1948, p. 9) show that the hydraulic gradient before development of wells in the "1,400-foot" sand was 2.5×10^{-4} and that the transmissibility was 1.2×10^{5} gpd per ft. Based on these figures the average amount of water that moved westward across a 1-mile section of the "1,400-foot" sand aquifer was about 0.16 mgd, compared to 1 mgd for the "500-foot" sand aquifer.

This rate of movement is equal to the natural discharge and recharge before the development of wells in the aquifer.

PUMPING

The average daily rate of withdrawal of water from the "1,400-foot" sand in the Memphis area between 1935 and 1960 is shown in figure 6. During the period 1947–60 the annual pumpage ranged from 10 to 14 mgd and averaged about 12 mgd. The slope of the present hydraulic gradient in the area 15–30 miles from the center of heavy withdrawal has developed in response to this constant rate of withdrawal, and near-equilibrium conditions of discharge, recharge, and water level now exist.

In 1924, before the development of wells in the "1,400-foot" sand, was equal to the amount of recharge, or about 5 mgd. Pumps within the area now intercept all the water that formerly was discharged naturally from the area.

Total discharge, or the amount of water withdrawn from 1924 to 1960, is about 120 billion gallons. If we use a coefficient of storage of 3×10^{-4} and a total water-level decline of 74 feet (in the Parkway well field), the amount of storage depletion in the aquifer is about 12 billion gallons. The average annual rate of depletion of storage in the aquifer is 10 percent of the present average daily rate of pumping, or about 1 mgd.

OTHER AQUIFERS

The Ripley Formation of Cretaceous age may be a major source of water in the future. The top of the Ripley lies about 2,600 feet below land surface at Memphis, and, at present, only one well, in the Parkway well field, is screened in the formation. The piezometric surface of this aquifer is more than 100 feet above land surface, and when this well was allowed to flow, it produced about 35 gpm. The water contains more than 1,000 ppm (parts per million) total dissolved solids and is not fit for most uses without treatment.

Terrace deposits consisting of sand and gravel of Pleistocene and (or) Pliocene age may also be a major future source of water. These deposits lie at or near land surface where they are present and may be as much as 100 feet thick. Several domestic wells screened in this aquifer yield as much as 50 gpm, and it is probable that large capacity wells could be developed in some places in the area. Water from the terrace deposits is hard but generally contains less iron than does the water from either of the principal aquifers. Water from the terrace deposits is suitable for some industrial uses without treatment, though none of the industries in the area use water from this source.

QUALITY OF WATER

Water that moves through underground formations comes into contact with and dissolves soluble material in the rocks, thereby changing the chemical quality of the water. Differences in the quality of ground water reflect differences in the geologic environment in the water-bearing formations. Formations lying at considerable depth below the surface and those which yield water derived from distant sources usually contain water that is more highly mineralized than do those which lie at shallow depth or obtain water from nearby sources. A complete discussion of the significance of the chemical and physical characteristics of water was prepared by Lohr and Love (1954, p. 3-13).

The value of a water supply is largely dependent on the quality of the water required for various uses. Water from the two principal aquifers in the Memphis area is of good chemical quality for municipal use and contains chemical constituents in concentrations well below those recommended by the U.S. Public Health Service for water used on interstate carriers. Iron concentration and hardness of water are usually the most troublesome chemical qualities. Iron concentration, hardness, and total dissolved solids in selected samples from the two principal aquifers are shown in figure 10.

The bacteriological quality of water from the "500-foot" and "1,400-foot" sand aquifers in the Memphis area is excellent because of the great depth to the water and because a local ordinance requires filling of abandoned wells with clay and cement. The only aquifer which could become seriously polluted from the land surface is the terrace deposits, and this aquifer is not used extensively for supply where pollution would be likely.

Industrial wastes and sewage do not currently pose a pollution problem, because these materials are discharged to the Mississippi River and are not allowed to accumulate in large amounts at any place in the area. Discharge of waste water to wells is prohibited by municipal ordinance in Memphis and Shelby County.

WATER IN THE "500-FOOT" SAND

The chemical quality of water in the "500-foot" sand is good. The only dissolved constituents that are troublesome are iron, free carbon dioxide, and, in a few places, hydrogen sulfide. Iron is easily removed by aeration and filtration, and most free carbon dioxide and hydrogen sulfide escape as the water is pumped from the ground or during the aeration for iron removal.

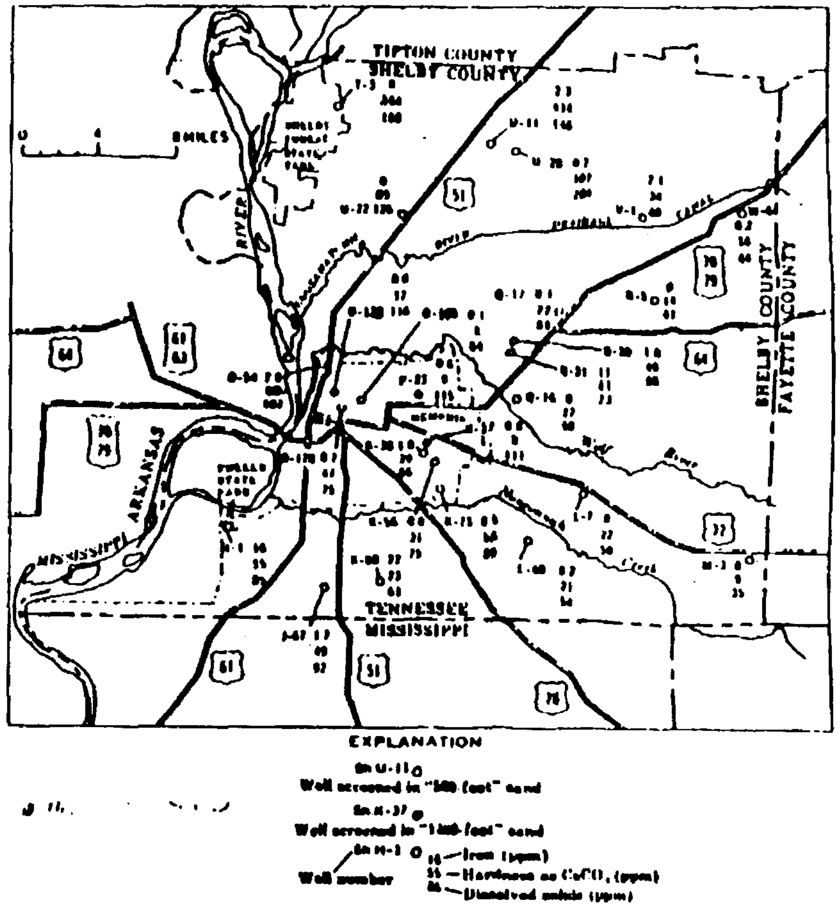


FIGURE 10.—Iron concentration, hardness, and total dissolved solids of water from selected wells in the "500-foot" and "1,400-foot" sands.

The water temperature ranges from 61° to 64°F, depending on the depth from which the water is pumped. The temperature of the ground water in the Memphis area increases about 1°F per 100 feet of depth below the ground surface, starting at 61° F at a depth of about 100 feet.

The water is generally soft. The average hardness determined from random sampling is about 40 ppm, having a range from 10 to 170 ppm. The highest values, above 60 ppm, may be a result of harder water leaking from the overlying terrace deposits and mixing with water in the "500-foot" sand. More water will probably be induced from the shallower formation as pumping continues to increase.

Determinations of pH made immediately after samples were collected showed the water to be acid, but a neutral condition was approached within a few minutes after collection as a result of the escape of carbon dioxide. The average pH of the water after it has been standing for a few hours is about 6, indicating a slightly acid condition. A typical chemical analysis of water from the "500-foot" sand is shown in table 2. The sample was analyzed several days after it was collected, and for this reason the pH determination was comparatively high.

TABLE 2.—*Typical chemical analysis of water from the "500-foot" sand*

[Chemical analysis of water from well Sh:O-120 in the "500-foot" sand. Well data: diameter, 10 inches; depth, 3[illegible]7 ft; drilled, 1942. Water data: color, 6; pH, 7.0; temperature, 62° F; date of collection, 4-2-31; specific conductance (micromhos at 25° C) 120. Analysis by U.S. Geol. Survey]

Constituent	Parts per million	Equivalents per million	Constituent	Parts per million	Equivalents per million
Aluminum (Al)	0.0	------	Sulfate (SO_4)	3.2	0.067
Silica (SiO_2)	13	------	Chloride (Cl)	3.0	.085
Iron (Fe)	.44	------	Fluoride (F)	.0	.000
Calcium (Ca)	10	0.499	Nitrate (NO_3)	.4	.006
Magnesium (Mg)	5.5	.452	Dissolved solids	81	------
Sodium (Na)	8.2	.357	Hardness as $CaCO_3$:		
Potassium (K)	1.3	.033	Total	46	------
Bicarbonate (HCO_3)	72	1.180	Noncarbonate	0	------

The water for municipal use in Memphis is treated for iron removal only. This treated water, which includes water from the "1,400-foot" sand, contains about 100 ppm total dissolved solids. A few of the industries requiring water of special chemical quality treat the water for the removal of certain constituents, but most of them use the water untreated. The Memphis Light, Gas, and Water Division is equipped to add chlorine to the water as a protective measure, but chlorine is not routinely added.

WATER IN THE "1,400-FOOT" SAND

The chemical quality of water from the "1,400-foot" sand is good (table 3), but the water is generally more highly mineralized than water from the "500-foot" sand. The hardness (as $CaCO_3$) is lower, ranging from 5 to 17 ppm. Water from the "1,400-foot" sand is untreated for municipal use, except for iron removal, and is mixed with water from the "500-foot" sand in the municipal system. Treatment for iron removal also removes the small amount of free carbon dioxide and hydrogen sulfide from the water.

Table 3 shows a typical chemical analysis of water from the "1,400-foot" sand. The pH is neither representative of water in the formation nor representative of water immediately after pumping, because the analysis was made several days after collection of the water sample.

During this time the escape of free carbon dioxide from the water caused an increase in the pH. No carbon dioxide or pH determinations have been made immediately after collection of water samples from this formation, but such analyses probably would be similar to those made of water from the "500-foot" sand.

TABLE 3.—*Typical chemical analysis of water from the "1,400-foot" sand*

[Chemical analysis of water in well Sh:K-[illegible] in the "1,400-foot" sand. Well data: diameter, 8 inches; depth 1,300 ft; drilled in 1941. Water data: color, 17; temperature 70° F; date of collection, 4-3-41; specific conductance (micromhos at 25°C), 160. Analysis by U.S. Geol. Survey]

Constituent	Parts per million	Equivalents per million	Constituent	Parts per million	Equivalents per million
Aluminum (Al)	0.7	------	Sulfate (SO_4)	5.1	0.106
Silica (SiO_2)	12	------	Chloride (Cl)	2.0	.056
Iron (Fe)	.60	------	Fluoride (F)	.1	.005
Calcium (Ca)	2.7	0.135	Nitrate (NO_3)	.5	.008
Magnesium (Mg)	1.3	.107	Dissolved solids	112	------
Sodium (Na)	35	1.522	Hardness as $CaCO_3$		
Potassium (K)	2.5	.064	Total	12	------
Bicarbonate (HCO_3)	101	1.655	Noncarbonate	0	------

Samples collected in 1927 and at infrequent intervals afterward indicate that the quality of water in the "1,400-foot" sand has remained constant. If leakage to the aquifier occurred in substantial amounts from rocks either below or above, it would undoubtedly be noted in the chemical analyses of the water because of the difference in quality of water in adjacent formations. The constancy of quality in the area where the pressure head is lowered considerably is further indication that the clays confining this artesian aquifier have very low permeability.

WATER IN OTHER AQUIFERS

Chemical analyses of the few samples of water obtained from the terrace deposits in the Memphis area show that the water is generally hard but that it contains less iron and carbon dioxide than does the water from the two principal aquifers. The average hardness (as $CaCO_3$) of water from the "500-foot" sand is about 40 ppm, and the average hardness of water from the terrace deposits, about 200 ppm. If the "500-foot" sand is locally recharged by seepage from the terrace deposits in any part of the area, sampling for chemical quality may be used to indicate the location and amount of such recharge. This [illegible] of the objectives of a continuing investigation.

Analyses of several samples of water from the only well screened in the Ripley Formation (about 2,600 ft deep) in the Memphis area show that the water contains more than 1,000 ppm total dissolved solids and is saline. The chemical quality of the water has not changed appreciably since the first sample was collected in 1927. Samples of water from this aquifer 80–100 miles east of Memphis contain as little as one tenth of the amount of dissolved solids found in water at Memphis, thus indicating the rate of change in chemical quality as the water moves downdip toward Memphis.

FACTORS AFFECTING FUTURE USE AND DEVELOPMENT

The foremost consideration at present is whether or not pumping from the principal aquifers in the Memphis area can continue to increase each year, as it has in the past, without causing the abandonment of many wells or a major change in the chemical quality of the water. The answer is a qualified "yes," although, as the development of new wells in the aquifers continues, pumping costs rise primarily as a result of declining piezometric surface and the higher initial cost of developing new wells at greater depths. Other factors which may affect future development include loss of artesian head, change in chemical quality as a result of induced recharge from adjacent formations or from surface water in certain locations, change in hydraulic characteristics of the aquifer, development of wells in shallower or deeper aquifers, development of surface-water supplies where water-quality tolerances are lower, and discovery of new industrial processes which may reduce or increase water consumption. All these factors are of immediate concern in long-range water management, but none appear to offer reasons for curtailment of development of wells at the current rate in either of the principal aquifers. Some of the factors, such as development of surface-water supplies and development of wells in deeper or shallower aquifers, would tend to conserve water in the "500-foot" and "1,400-foot" sands.

Water wells can be developed in either of the principal aquifers anywhere in the Memphis area, but the amount of water discharged by a well per unit drawdown of water level, defined as specific capacity, cannot be predicted accurately because of the nonhomogeneity of the sands and the sporadic presence of clay beds of varying thicknesses in some parts of the area. The size, capacity, and type of construction of a well, the size and length of the well screen, the kind of gravel envelope around the screen, the pumping rate, and the hydraulic properties of the water-bearing formation in the vicinity of the well affect the specific capacity. Theoretically, transmissibility can be used to predict specific capacity of a proposed well where other factors are known. The specific capacity of wells in the Memphis area ranges from a few to more than 100 gpm per foot of drawdown for wells of all sizes and all types of construction. The specific capacity of an average 10-inch well in the "500-foot" sand is about 30 gpm per foot of drawdown.

In the area east of a southwest-trending line through Collierville,

has declined below the top of the aquifer, and nonartesian conditions now prevail in that area. As pumping continues to increase, the artesian-nonartesian boundary will migrate toward Memphis, and, eventually, when the water level in Memphis has declined 300–400 feet below land surface, nonartesian conditions will encompass the entire area. When the present annual pumping rate is doubled, the boundary will have advanced to the present city limits of Memphis. If the current annual increase in pumping rate continues and if the present areal pumping pattern continues to develop, nonartesian conditions will reach the city limits of Memphis in about 30 years (1990). Variations in the future pumping pattern may hasten or delay the approach of nonartesian conditions in the "500-foot" sand. The present practice of wider well and well-field spacing will tend to preserve the artesian condition.

The impending loss of artesian head in the aquifer is not cause for alarm. On the contrary, water levels should fluctuate less and decline more slowly. Some water may be induced from the overlying terrace deposits and cause a change in the chemical quality of water, although probably not a significant amount. The amount of land subsidence resulting from dewatering of the aquifer will probably be immeasurably small unless the water level declines several hundred feet below the top of the aquifer. Nonartesian conditions will result in a relatively small additional cost of developing deeper wells and a slightly higher cost of pumping.

Development of wells in, and use of water from, the "500-foot" sand probably will continue so long as the quality of the water is satisfactory. The coefficient of transmissibility for the "1,400-foot" sand is about 1.2×10^5 gpd per ft, and for the "500-foot" sand about 4×10^5. The ratio is about 1 to 3, indicating that three times as much water may move through the "500-foot" sand. The hydraulic diffusivity, defined as the ratio of the coefficient of transmissibility to the coefficient of storage, for the "1,400-foot" sand is 4×10^6, and the "500-foot" sand it is 1.33×10^6. The ratio is 3 to 1, which indicates that the effect of any change in the rate of discharge travels three times farther in the "1,400-foot" sand. The estimated rate of movement of water under natural conditions, prior to development of the "1,400-foot" sand aquifer, was about 0.16 mgd for each 1-mile-wide section of the aquifer; for the "500-foot" sand, about 1 mgd. These values indicate that the ultimate capacity or economic yield of the "1,400-foot" sand is about 16 percent of that of the "500-foot" sand under similar conditions.

ADEQUACY OF THE AQUIFER ANALYSIS

Determinations of the rate of movement of water, the natural and artificial discharge, the indication and effect of recharge, and the hydraulic characteristics of the two principal aquifers in the Memphis area are results of the application of mathematical formulas to the data collected for these purposes. Geological and geophysical data collected during the investigation contributed to, and tended to verify, these results. The analyses are adequate for the current (1960) rate of pumping and location of well fields. Only the total amount of water involved and its rate of movement is expected to change significantly in the future. The hydraulic characteristics described in this report may be used to predict the results of these changes throughout the area except where the "500-foot" sand is no longer under artesian pressure. Tests will have to be conducted in areas where nonartesian conditions exist to determine the hydraulic characteristics of the aquifer. In such areas, however, pumping is expected to have a less pronounced effect on the water level than it has in the artesian part of the area.

In general the aquifer analysis as presented in this report is sufficiently adequate to predict with reasonable accuracy the future water-level changes for given rates of pumping, either greater or smaller than the present rate. The analysis also indicates that greater amounts of water may be pumped from both aquifers without impairing the water supply or seriously affecting the quality of water.

CONCLUSIONS

The two principal aquifers of the Memphis area are the "500-foot" and "1,400-foot" sands, from which practically all the water used in the area is pumped. The present (1960) rate of withdrawal is about 150 mgd, 135 mgd of which is pumped from the "500-foot" sand. Of the inflow to the area through the "500-foot" sand, excluding leakage from streams and adjacent aquifers, about 45 percent is from the east, about 20 percent is from the south, about 15 percent is from the north, and about 10 percent or less is from the west. The remaining 10 percent of the water derived annually from the "500-foot" sand comes from depletion of storage as a result of declining water level and from leakage from the overlying terrace deposits which, in turn, may be partly recharged by streams and by precipitation. Faults in the area may influence water movement and water levels by retarding the inflow of water from the west.

Pumping tests were made to determine the hydraulic characteristics of that section of the "500-foot" sand aquifer adjacent to the well

170000

is estimated to have a coefficient of transmissibility of about 4×10^{5} gpd per ft and a coefficient of storage of about 3×10^{-3}. The long-range effect on water levels in the area may be determined by using these coefficients for any given rate of pumping and computing the future drawdown. For example, if the present pumping rate from the "500-foot" sand remains constant, water levels will cease to decline within a few years. However, if the annual pumping rate from the "500-foot" sand continues to increase at the present rate of approximately 5 mgd per year, water levels will decline at about the same rate as at present unless future wells and well fields are located at greater distances from the present centers of pumping.

The water level in the "500-foot" sand in the southeastern part of the Memphis area has declined to a few feet below the top of the aquifer. The line marking the boundary between artesian and nonartesian conditions is slowly advancing toward Memphis, and, in about 30 years, nonartesian conditions may exist over the entire area. No detrimental effect can be forecast, though the quality of the water pumped may change slightly as water is induced from adjacent formations and streams. Water-level fluctuations and the overall decline in water levels probably will be less pronounced than at the present, although transmissibility will decrease as the aquifer is drained.

The "1,400-foot" sand, an almost ideal artesian aquifer, is a secondary aquifer because it is only about one fourth as thick as the "500-foot" sand and, therefore, can furnish only one fourth as much water or less. The coefficient of transmissibility in the "1,400-foot" sand is 1.2×10^{5} gpd per ft, or about the same as that in the "500-foot" sand per unit of thickness. The storage coefficient is 3×10^{-4} indicating that less water is derived from storage per foot of water-level decline than is derived from the "500-foot" sand. The effect of pumping on the water level in this aquifer is also more pronounced at greater distances from the center of pumping than is the effect on the water level in the "500-foot" sand, primarily because of the greater artesian head in the "1,400-foot" sand.

The present (1960) rate of pumping from the "1,400-foot" sand in the Memphis area is about 13 mgd, and a total of about 120 billion gallons is estimated to have been withdrawn since the first wells were developed in 1924. The aquifer is primarily a standby source of water for the city of Memphis.

Part of this investigation was directed toward answering specific questions relating to water supply that might be asked by those charged with planning for an expanding community. Kazmann (1944, p. 17–18) expressed the problems of the Memphis area water

ADEQUACY OF THE AQUIFER ANALYSIS

Determinations of the rate of movement of water, the natural and artificial discharge, the indication and effect of recharge, and the hydraulic characteristics of the two principal aquifers in the Memphis area are results of the application of mathematical formulas to the data collected for these purposes. Geological and geophysical data collected during the investigation contributed to, and tended to verify, these results. The analyses are adequate for the current (1960) rate of pumping and location of well fields. Only the total amount of water involved and its rate of movement is expected to change significantly in the future. The hydraulic characteristics described in this report may be used to predict the results of these changes throughout the area except where the "500-foot" sand is no longer under artesian pressure. Tests will have to be conducted in areas where nonartesian conditions exist to determine the hydraulic characteristics of the aquifer. In such areas, however, pumping is expected to have a less pronounced effect on the water level than it has in the artesian part of the area.

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Part of this investigation was directed toward answering specific questions relating to water supply that might be asked by those charged with planning for an expanding community. Kazmann (1944, p. 17–18) expressed the problems of the Memphis area water maximum amount of water that can be pumped safely from the aquifers be determined. That limit cannot be determined at present because the change from artesian to nonartesian conditions and the decentralization of pumping tends to increase the maximum safe amount of water that may be obtained in the area. Therefore, the answers to Kazmann's questions are qualified and reflect the status of knowledge of the area for the period ending with this investigation. The questions will continue to be the basis for a logical continuing investigation if supplemented by other pertinent questions which are listed in the final pages of this report.

1. What is the origin of the ground water obtained in the Memphis area?

At present about 90 percent of the water obtained from the "500-foot" sand originates as underground inflow into the area. Less than 1 percent of the water comes from depletion of the storage of the aquifer. The remainder, about 10 percent, is leakage from the overlying terrace deposits or from other sources of recharge in the area.

About 10 percent of the water obtained from the "1,400-foot" sand comes from depletion of the storage of the aquifer. The other 90 percent probably originates as inflow into the area.

2. Is more water being taken from the underground sources than nature puts back each year? If so, what is the excess of average withdrawal over input? If not, what is the ultimate safe yield of the water-bearing formations?

Presently, the answer is yes. More water is being taken from the aquifers than is being replaced each year because of the annual increase in pumping. However, if the annual pumping rate remained constant, equilibrium conditions would be reached within a few years, and the amount of recharge would equal discharge on an annual basis.

If each aquifer is considered as a unit ending at the boundary of the Memphis area and if a comparison is made of what is added to each of these units by inflow and any other processes with what has been taken out, then the difference is the amount of depletion of storage of each aquifer in the area. The average annual rate of depletion of storage of the "500-foot" sand in the area is less than 1 percent of the annual pumping rate, or about 1 mgd. Therefore, 99 percent of the water taken annually from the "500-foot" sand within the area is replaced by recharge.

Similarly, about 90 percent or more of the water that has been taken from the "1,400-foot" sand in the area has been replaced. Rising water levels in this aquifer indicate that recharge has been greater than discharge during the past 4 years.

3. Are the water-bearing formations continuous between the outcrops (if any) and the well fields?

The answer is yes. This continuity is shown by the influence of pumping from both the "500-foot" and the "1,400-foot" sands on the water levels in observation wells 30 miles northeast of Memphis (figs. 9, 17). Recharge to the aquifers

observation wells. These facts indicate that the two aquifers are hydraulically continuous between their outcrop areas and the well fields in the Memphis area. Continuity within the area is proven by geophysical logs.

4. How much water are the formations capable of transmitting each day?

Throughout their total thickness in the Memphis area, the "500-foot" sand has a coefficient of transmissibility of 4×10^5 gpd per ft, and the "1,400-foot" sand, about 12×10^4 gpd per ft. The amount of water the formations are capable of transmitting is indicated by these coefficients and by the hydraulic gradient in each aquifer in the area. The present steepest gradient outside the area of heavy pumping is about 10 feet per mile in the "500-foot" sand, and about 4 mgd is transmitted in each 1-mile-wide section of the aquifer along a north-south line in the vicinity of well Sh:Q-1 (pl. 2). The present steepest gradient is about 3 feet per mile in the "1,400-foot" sand, and about 0.36 mgd is transmitted in each 1-mile-wide section of the aquifer in the vicinity of the Sheahan well field (pl. 2). The extent to which these gradients can be increased is unknown, but it is certain that both aquifers can supply more water than is presently pumped from them.

5. Is the limit on water withdrawals set by the recharge to the formations or the transmissibility of the formations?

The limit on water withdrawal for a well field or for a small part of the Memphis area depends on the transmissibility of the aquifer and the geohydrologic conditions in the vicinity of the well field. For example, the presence of a local clay lens in the aquifer will lower the limit of withdrawal for a well field. Similar clay lenses may be so spaced in or near the outcrop area to prevent maximum recharge that would otherwise take place. The present annual pumping rate in the Memphis area is not great enough to determine which of the two factors limit the rate of withdrawal. If the rates of recharge under ultimate development of the aquifers are assumed to be the same as those prior to development, then the limit on withdrawal would be set by the recharge to the formations. However, perennial streams flowing across the sandy outcrop areas strongly suggests the possibility of large amounts of rejected recharge. The amount and maximum possible rate of recharge may be great enough that withdrawals may be limited by the transmissibilities of the formations. This limitation appears to be the most likely conclusion.

6. Are the chemical quality and temperature of ground water changing or are they constant within certain limits?

The water samples analyzed since 1927 show that the chemical quality of water from both aquifers varies little with time except for the hardness of "500-foot"-sand water which appears to be increasing in the north-central part of the area (fig. 19). The temperature of water in the "500 foot" sand ranges from 61° to 64° F depending on the depth of the well; the temperature of water in the "1,400-foot" sand ranges from 70° to 71° F.

7. What directions are the most promising for the establishment of new well fields and what is the most desirable well spacing?

The preferable direction for the establishment of new well fields in the "500-foot" sand is unknown, although the southeastern part of the area is indicated because the greater rate of inflow is from that direction. The hydraulic characteristics of the aquifer under nonartesian conditions, the hydrologic condition of the outcrop area, and the influence of geologic features in the area could alter the selection of preferable direction as pumping continues.

The question of well spacing is primarily a problem of economics relating to water production and transportation. Obviously, the greater distance between production wells causes less interference, but the cost of distributing the water on the land surface is greater. The drawdown in a well pumping 1,000 gpm from the "500-foot" sand is about 50 feet. If the allowable interference of another pumping well is 10 percent of its own drawdown and the wells are similar in construction and depth to presently used wells in the Memphis area, the well spacing should be 1,000 feet or more. If the wells are constructed using longer screens, a greater thickness of the aquifer would be effective, and closer well spacing would be allowable.

The preferable direction for the development of new well fields in the "1,400-foot" sand is roughly north and south of Memphis or perpendicular to the flow path of water moving downdip in the aquifer into the area. Well spacing, under requirements similar to those for the "500-foot" sand should be 1,000 feet or more.

8. What is the relationship between ground-water levels and quantities of water pumped in the area?

Water levels decline in the Memphis area as a result of increases in pumping. The water levels would cease to decline if the total annual pumping rate remained constant for a few years. Generally, for the "500-foot" sand, the decline in Memphis is about 1 foot for each 1-mgd increase in water production in Memphis. In observation wells about 30 miles northeast of Memphis, the water-level decline is less than 0.1 foot for each 1-mgd increase in water production in Memphis.

The water-level decline in the "1,400-foot" sand is at present as much as four times greater than that in the "500-foot" sand for each 1-mgd increase in water production.

9. How much water is being obtained from each water-bearing formation?

Approximately 1.9 trillion gallons of water was pumped from the "500-foot" sand from 1880 to 1900. Records of pumpage are accurate, and during the past several years more than half the daily pumpage in the area was metered and reported monthly to the U.S. Geological Survey. The 1900 rate of pumping was about 135 mgd. All the water pumped from the "1,400-foot" sand is metered also, and more than 95 percent of the daily pumpage is reported monthly. The total amount of water pumped from the "1,400-foot" sand from 1924 to 1900 was about 120 billion gallons. The 1900 rate of pumping was about 13 mgd.

Supplemental questions which need to be answered during the continuing investigation in order to promote further efficient management of the water supply in the Memphis area are:

1. What is the amount of recharge perennially available, and can the aquifers accept and transmit the total available recharge?
2. What are the steepest hydraulic gradients that can be established in the aquifers?

3. What are the hydraulic characteristics of the aquifers under impending nonartesian conditions, and will surface-water resources in the area be affected?
4. What are the effects of faults and similar structural controls on water production?
5. What are the interference effects, resulting from different heads or water levels in the aquifers, between aquifers?
6. What is the change in chemical quality of water as production from the aquifers continues? Is it significant, and is there a trend toward greater change?
7. Will streamflow be significantly affected as the effect of pumping in Memphis extends to the outcrop area of the two principal acquifers?
8. Should the shallower terrace deposits or alluvium be considered a major source of water, or are they being drained by leakage to the "500-foot" sand?
9. What are the legal and economic aspects of continued development?

There are no apparent reasons why development of wells in the two principal aquifers of the Memphis area should not continue, although the supply is not unlimited. Any evidence of overdevelopment would probably be noted during the continuing future investigation in sufficient time to prepare solutions to the problem or to recommend that alternate sources of supply be developed. The potential water production from the two aquifers is much greater than the present yield, and the possibility of overdevelopment of either aquifer in the immediate future is remote.

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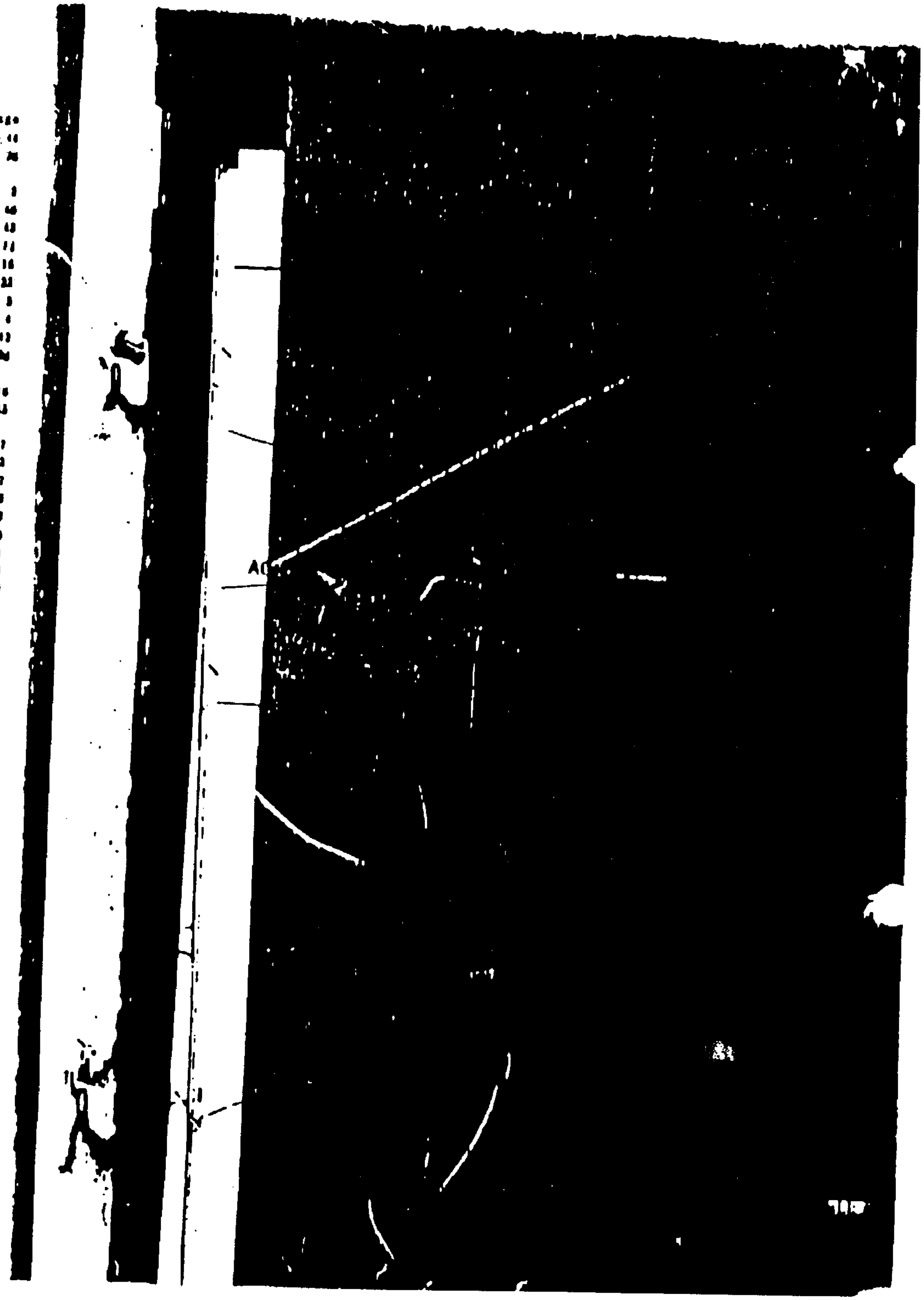
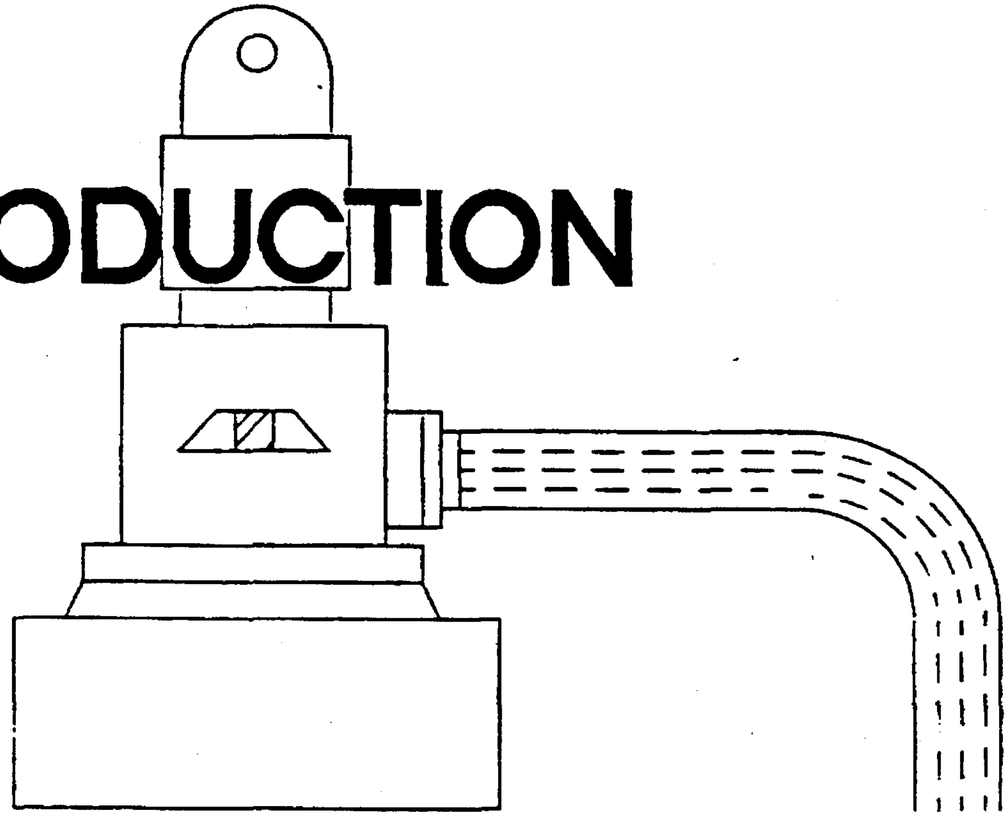


MLGW

WATER



PRODUCTION

1990

MLGW WATER PRODUCTION

TREATMENT PLANT

DATA

TREATMENT PLANT DATA

PUMPAGE (RATED)

STATION	PLANT FLOW (MGD)	AERATOR RISERS (No)	AERATOR FLOW RATE (GPM/SQ.FT.)	FILTER BOX (No)	FILTER FLOW RATE (GPM/SQ.FT.)	DISCHARGE PRESSURE (PSI)	H.S. PUMPS (No.)	PUMPAGE (MGD)
MALLORY	35	16	23.74	8	3.68	87	4	60
SHEAHAN #1	35	17	12.61	10	2.95	72	4	60
SHEAHAN #2	--	8	26.30	-	----	--	-	--
ALLEN	30	14	23.25	10	2.55	76	4	60
McCORD	35	14	27.13	4	7.45	76	5	60
LICHTERMAN	30	14	23.25	4	6.38	68	5	60
LICHTERMAN (WITH BYPASS)	35	14	27.13	4	7.45	--	-	--
PALMER	5.5	2	15.91	6	3.18	60	3	8
DAVIS	15	4	25.00	4	2.89	77	2	35
DAVIS #1 (FUTURE)	32.5	4	25.00	4	6.26	77	4	55
DAVIS #2 (FUTURE)	--	8	23.74	-	----	--	-	--
MORTON	15	7	23.25	4	2.50	74	3	37.5
MORTON (FUTURE)	30	14	23.25	4	5.00	74	5	62.5
SHAW	15	8	20.35	4	2.50	57	3	31.5
SHAW LOWER (FUTURE)	30	16	20.35	4	5.00	57	4	42
SHAW UPPER (FUTURE)	--	-	----	-	----	78	3	22.5
LNG	1.1	1	10.40	1	3.24	70	3	0.9

TREATMENT PLANT DATA

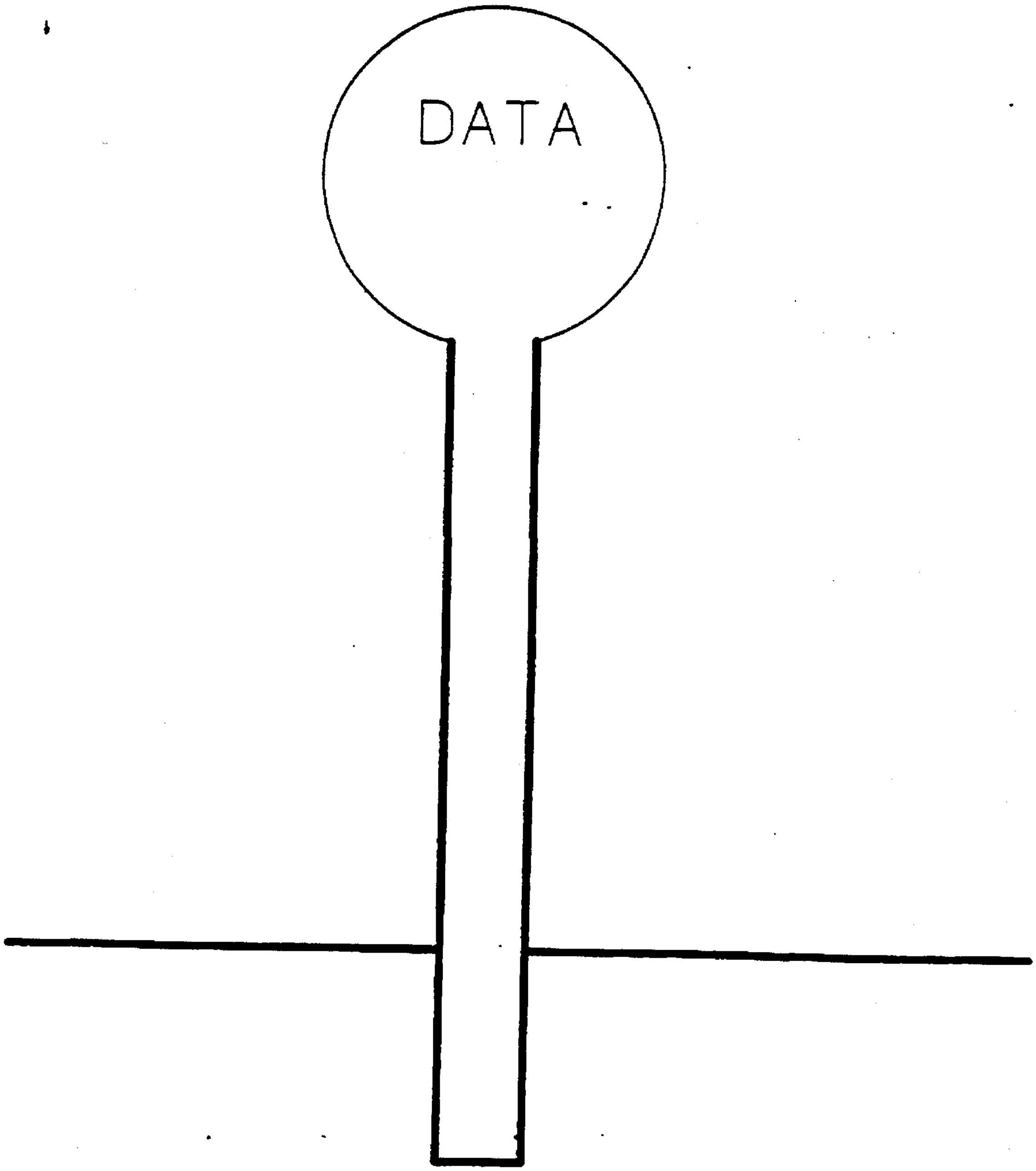
AERATORS

	NO. OF RISERS	WIDTH IN FT.	LENGTH IN FT.	SECTIONS PER RISER	AREA SQ. FT.	TRAYS HIGH
MALLORY	16	4	8	2	64	9
SHEAHAN #1	17	3	6.75	2	40.5	9
SHEAHAN #2	8	4.5	8.25	2	74.25	9
ALLEN	14	4	8	2	64	9
McCORD	14	4	8	2	64	9
LICHTERMAN	14	4	8	2	64	9
DAVIS #1	4	5	10.417	2	104.17	9
DAVIS #2 (FUTURE)	8	4	8	2	64	9
MORTON	7	4	8	2	64	9
MORTON (FUTURE)	14	4	8	2	64	9
SHAW	8	4	8	2	64	9
SHAW (FUTURE)	16	4	8	2	64	9
PALMER	2	4	15	2	120	9
L.N.G.	1	4.5	16	21	72	6

FILTERS

	NO. OF BOXES	WIDTH IN FT.	LENGTH IN FT.	SECTIONS PER BOX	AREA SQ. FT.	TYPE MEDIA
MALLORY	8	12.5	33	2	825	mixed
SHEAHAN #1	10	12.5	33	2	825	mixed
ALLEN	10	12	34	2	816	sand
McCORD	4	12	34	2	816	mixed
LICHTERMAN	4	12	34	2	816	mixed
DAVIS #1	4	15	30	2	900	mixed
MORTON	4	13.167	39.5	2	1040.1	mixed
MORTON (FUTURE)	4	13.167	39.5	2	1040.1	mixed
SHAW	4	13.167	39.5	2	1040.1	mixed
PALMER	6	10	20	1	200	sand
L.N.G.	1	17.167	DIA	1	231.46	mixed

LIFT SYSTEM



LIFT SYSTEM DATA

NORTH COUNTY SYSTEM

PUMPING STATION

RATED CAPACITIES	LNG
NUMBER OF WELLS	2
CAPACITY (MGD)	
PUMP #1	0.4
PUMP #2	0.4
PUMP #3	0.3
GROSS PUMPAGE	1.1
TREATMENT	0.7
STORAGE (MG)	0.3
PUMP ELEVATION (FT.)	331
HYDROSTATIC HEAD (FT.)	493.5

LIFT STATIONS

RATED CAPACITIES	ORGILL
CAPACITY (GPM)	
PUMP #1	500
PUMP #2	500
GROSS PUMPAGE (GPM)	1000
LIFT (FT.)	
PUMP #1	128
PUMP #2	128

LIFT SYSTEM DATA

EAST COUNTY SYSTEM

PUMPING STATION

RATED CAPACITIES	SHAW (FUTURE)
NUMBER OF WELLS	10
CAPACITY (MGD)	
PUMP #1	--
PUMP #2	7.5
PUMP #3	--
PUMP #4	7.5
PUMP #5	--
PUMP #6	7.5
PUMP #7	--
GROSS PUMPAGE	22.5
TREATMENT (MGD)	15
STORAGE (MG)	15
PUMP ELEVATION (FT.)	364
HYDROSTATIC HEAD (FT.)	495

LIFT STATIONS

RATED CAPACITIES	ROCKY PT.	PISGAH	HOUSTON LEVEE	GERMANTOWN RD.
CAPACITY (GPM)				
PUMP #1	440	750	600	800
PUMP #2	---	750	200	800
PUMP #3	---	---	---	2000
PUMP #4	---	---	---	2000
GROSS PUMPAGE (GPM)	440	1500	800	5600
LIFT (FT.)				
PUMP #1	127	80	210	164
PUMP #2	---	80	210	164
PUMP #3	---	---	---	125
PUMP #4	---	---	---	125

LIFT SYSTEM DATA

SOUTH COUNTY SYSTEM

RATED CAPACITIES	LIFT STATIONS CAPLEVILLE	ROSS RD.
CAPACITY (GPM)		
PUMP #1	350	2000
PUMP #2	---	825
GROSS PUMPAGE (GPM)	350	2825
LIFT (FT.)		
PUMP #1	110	108
PUMP #2	---	86

PRESIDENT ISLAND

RATED CAPACITIES	PRESIDENT ISLAND
CAPACITY (GPM)	
PUMP #1	3500
PUMP #2	3500
GROSS PUMPAGE (GPM)	7000
LIFT (FT.)	
PUMP #1	63
PUMP #2	63

LIFT SYSTEM DATA

ROSMARK

RATED CAPACITIES	ROSMARK
CAPACITY (GPM)	
PUMP #1	600
PUMP #2	125
GROSS PUMPAGE (GPM)	725
LIFT (FT.)	
PUMP #1	108
PUMP #2	64

INTERNAL BOOSTER STATIONS

RATED CAPACITIES	BROOKS RD.	SHELBY DR.	PARK AVE.
CAPACITY (GPM)			
PUMP #1	5500	3000	7500
PUMP #2	5500	3000	---
GROSS PUMPAGE (GPM)	11000	6000	7500
LIFT (FT.)			
PUMP #1	82	60	90
PUMP #2	82	60	--

LIFT SYSTEM DATA

LOWER SYSTEM

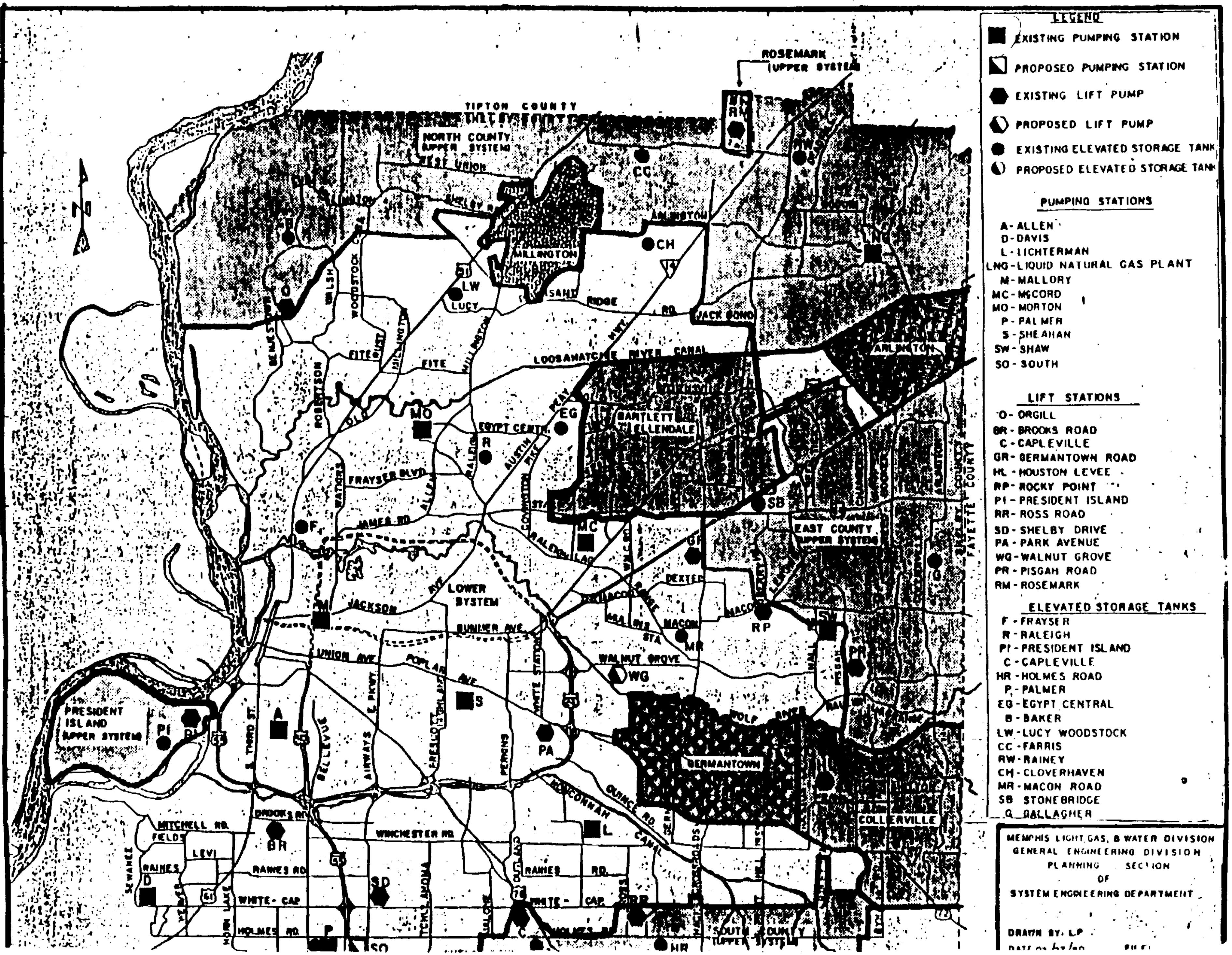
RATED CAPACITIES	MALLORY	SHEAHAN	ALLEN	McCORD	LICHTERMAN	DAVIS	MORTON	SHAW	PALMER	TOTAL
GENERATION (KW)	--	--	1000 (E)	--		--	--	1250 (E)	-	2250
NUMBER OF WELLS	25	23	26	24	23	14	10	10	4	159
HIGH SERVICE PUMPS (MGD)										
#1	15	15 (V)	15 (V)	5	10	10 (V)	12.5 (F)	10.5	2.2	--
#2	15	15 (V)	15 (V)	10 (V)	10 (V)	15 (F)	12.5 (V)	--	2.9	--
#3	15 (V)	15	15	15	15	15 (V)	12.5 (V)	10.5 (V)	2.9	--
#4	15 (V)	15	15 (V)	15 (V)	15 (V)	15 (F)	12.5	--	--	-
#5	15 (F)	4 (E)	--	15	15	--	12.5 (F)	10.5 (V)	-	--
#6	4 (E)	--	--	--	-	--	--	--	-	--
#7	--	--	--	--	--	--	--	10.5 (F)	--	--
TOTAL (MGD)	64	64	60	60	65	25	37.5	31.5	8	383.5
TOTAL (Future)	79	--	--	--	--	55	62.5	42	--	--
TREATMENT (MGD)	35	35	30	30	35	15	15	15	5.5	200.5
TREATMENT (Future)	--	--	--	--	--	30	30	30	-	--
STORAGE (MG)	23	18	20	10	10	10	10	15	2	118
STORAGE (Future)	--	--	--	20	20	20	20	25	--	--
PUMP ELEVATION (FT.)	251	299	294.5	303	328	269	304	364	317	--
HYDROSTATIC HEAD (FT.)	456	458.5	454	474	483	451	480	495	45[illegible]	-

NOTES: E = ENGINE DRIVEN UNIT; V = VARIABLE SPEED PUMP; F = FUTURE

LIFT STATION DATA

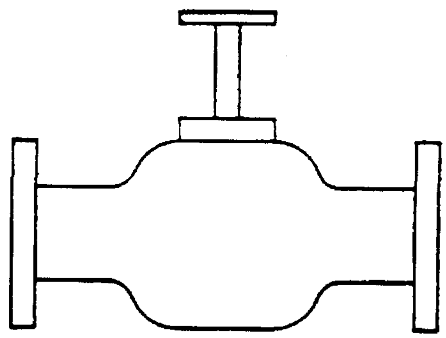
ELEVATED STORAGE TANKS

TANK	STREET ADDRESS	OVERHEAD STORAGE (Gal.)	OVERFLOW ELEVATION (FT)	SYSTEM
PALMER	1241 E.HOLMES	300,000	451.5	LOWER
FRAYSER	655 WHITNEY	500,000	415	LOWER
RALEIGH MILLINGTON	3704 RALEIGH-MILLINGTON	300,000	452.48	LOWER
EGYPT CENTRAL	5384 EGYPT CENTRAL	500,000	452.48	LOWER
LUCY	6440 CHASE	300,000	406	LOWER
CLOVERHAVEN	7604 SLEDGE	100,000	424	LOWER
MACON RD	7685 MACON RD.	200,000	484	LOWER
BAKER	7707 BENJESTOWN	500,000	493.5	NORTH COUNTY
FARRIS	6925 MUDVILLE	100,000	493.5	NORTH COUNTY
RAINEY	9907 REDWOOD	250,000	493.5	NORTH COUNTY
CAPLEVILLE	5234 E.HOLMES	100,000	510	SOUTH COUNTY
HOLMES RD.	7599 HOLMES RD.	500,000	530	SOUTH COUNTY
STONEBRIDGE	8894 HWY. 64	500,000	527	EAST COUNTY
GALLAGHER	2040 ARLINGTON-COLLIERVILLE	500,000	527	EAST COUNTY
PRESIDENT ISLAND	1720 DOCK	500,000	407	PRESIDENT IS.



LEGEND
EXISTING PUMPING STATION
PROPOSED PUMPING STATION
EXISTING LIFT PUMP
PROPOSED LIFT PUMP
EXISTING ELEVATED STORAGE TANK
PROPOSED ELEVATED STORAGE TANK
PUMPING STATIONS
A - ALLEN
D - DAVIS
L - LICHTERMAN
LNG - LIQUID NATURAL GAS PLANT
M - MALLORY
MC - MCCORD
MO - MORTON
P - PALMER
S - SHEAHAN
SW - SHAW
SO - SOUTH
LIFT STATIONS
O - ORGILL
BR - BROOKS ROAD
C - CAPLEVILLE
GR - GERMANTOWN ROAD
HL - HOUSTON LEVEE
RP - ROCKY POINT
PI - PRESIDENT ISLAND
RR - ROSS ROAD
SD - SHELBY DRIVE
PA - PARK AVENUE
WG - WALNUT GROVE
PR - PISGAH ROAD
RM - ROSEMARK
ELEVATED STORAGE TANKS
F - FRAYSER
R - RALEIGH
PI - PRESIDENT ISLAND
C - CAPLEVILLE
HR - HOLMES ROAD
P - PALMER
EG - EGYPT CENTRAL
B - BAKER
LW - LUCY WOODSTOCK
CC - FARRIS
RW - RAINEY
CH - CLOVERHAVEN
MR - MACON ROAD
SB STONEBRIDGE
G GALLAGHER
MEMPHIS LIGHT, GAS, & WATER DIVISION
GENERAL ENGINEERING DIVISION
PLANNING SECTION
OF
SYSTEM ENGINEERING DEPARTMENT
DRAWN BY: LP
ROSEMARK (UPPER SYSTEM)
TIPTON COUNTY
NORTH COUNTY UPPER SYSTEM
MILLINGTON
ARLINGTON
BARTLETT
ELLENDALE
EAST COUNTY UPPER SYSTEM
LOWER SYSTEM
GERMANTOWN
COLLIERVILLE
PRESIDENT ISLAND UPPER SYSTEM
SOUTH COUNTY UPPER SYSTEM
FAYETTE COUNTY
LOOSAHATCHIE RIVER CANAL
WOLF RIVER
NONCONNAH CANAL
JACKSON AVE
SUMMER AVE
UNION AVE
POPLAR AVE
WINCHESTER RD
MITCHELL RD
RAINES RD
WHITE - CAP
HOLMES RD

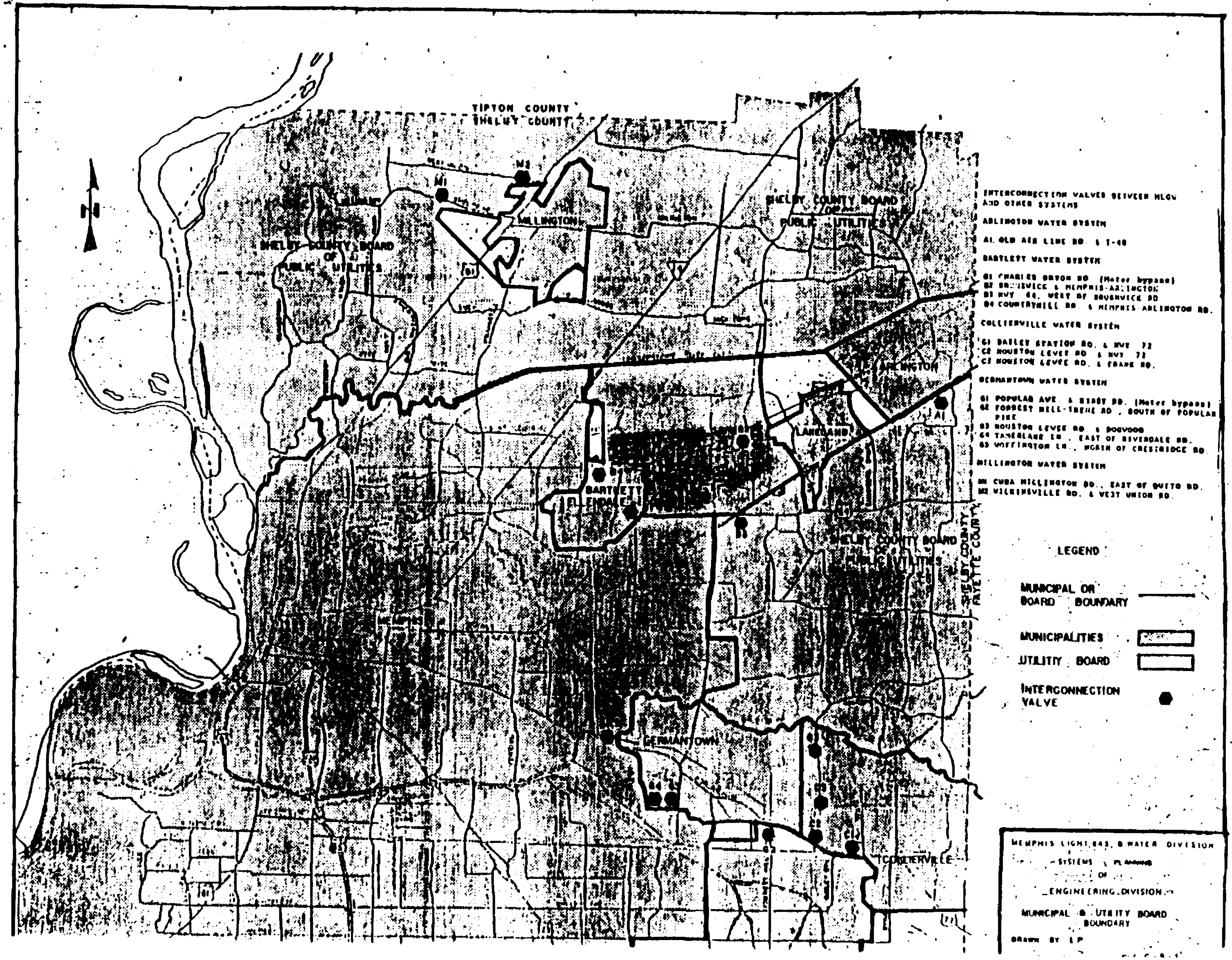
INTERCONNECTION VALVE



DATA

WATER SYSTEM INTERCONNECTION VALVES BETWEEN MLGW AND OTHER SYSTEMS
GENERAL LOCATION

	VALVE NO	PAGE NO	VALVE SIZE
ARLINGTON WATER SYSTEM			
1. OLD AIR LINE ROAD & I-40	1	301	8'
BARTLETT WATER SYSTEM			
1. CHARLES BRYAN RD. (METER BYPASS)	7	39	6'
2. BRUNSWICK & MEMPHIS-ARLINGTON	2	237	8'
3. HWY. 64 WEST OF BRUNSWICK ROAD	1	97	8'
4. COUNTRYHILL RD. & MEMPHIS-ARLINGTON RD.	9	149	8'
COLLIERVILLE WATER SYSTEM			
1. BAILEY STATION RD. & HWY. 72	2	1527	12'
2. HOUSTON LEVEE RD. & HWY 72	1	1527	8'
3. HOUSTON LEVEE RD. & FRANK RD.	1	1391	8'
GERMANTOWN WATER SYSTEM			
1. POPLAR AVE. & KIRBY RD. (METER BYPASS)	NOT NUMBERED	1265	6'
2. FORREST HILL-IRENE RD. SOUTH OF POPLAR PIKE	1	1455	12'
3. HOUSTON LEVEE RD. & DOGWOOD	1	1269	8'
4. TAMERLANE LN. EAST OF RIVERDALE ROAD	25	1447	6'
5. WOFFINGTON LN. NORTH OF CRESTRIDGE RD.	51	1447	6'
MILLINGTON WATER SYSTEM			
1. CUBA MILLINGTON RD. EAST OF QUITO RD.	1	511	6'
2. WILKINSVILLE RD. & WEST UNION RD.	6	537	8'



TIPTON COUNTY
SHELBY COUNTY
SHELBY COUNTY BOARD OF PUBLIC UTILITIES
MILLINGTON
ARLINGTON
LAKELAND
BARTLETT
GERMANTOWN
COLLIERVILLE
SHELBY COUNTY
FAYETTE COUNTY
INTERCONNECTION VALVES BETWEEN MLGW AND OTHER SYSTEMS
ARLINGTON WATER SYSTEM
A1 OLD AIR LINE RD. & I-40
BARTLETT WATER SYSTEM
B1 CHARLES BRYAN RD (Meter bypass)
B2 BRUNSWICK & MEMPHIS-ARLINGTON
B3 HWY 64, WEST OF BRUNSWICK RD
B4 COUNTRYHILL RD. & MEMPHIS-ARLINGTON RD.
COLLIERVILLE WATER SYSTEM
C1 BAILEY STATION RD. & HWY 72
C2 HOUSTON LEVEE RD & HWY 72
C3 HOUSTON LEVEE RD. & FRANK RD.
GERMANTOWN WATER SYSTEM
G1 POPULAR AVE. & STOUT RD. (Meter bypass)
G2 FORREST HILL-IRENE RD, SOUTH OF POPULAR PIKE
G3 HOUSTON LEVEE RD & DOGWOOD
G4 TANGLEWOOD LN, EAST OF RIVERDALE RD.
G5 WOTTINGTON LN., NORTH OF CRESTRIDGE RD
MILLINGTON WATER SYSTEM
M1 CUBA MILLINGTON RD., EAST OF QUITO RD.
M2 WILKINSVILLE RD. & WEST UNION RD.
LEGEND
MUNICIPAL OR BOARD BOUNDARY
MUNICIPALITIES
UTILITY BOARD
INTERCONNECTION VALVE
MEMPHIS LIGHT, GAS, & WATER DIVISION
SYSTEMS PLANNING
ENGINEERING DIVISION
MUNICIPAL & UTILITY BOARD BOUNDARY
DRAWN BY L.P.

Memphis Light Gas & Water Division 50th Anniversary MLGW
P.O. Box 430 Memphis, Tennessee 38101 Telephone (901) 528-4011

ANALYSIS OF WATER SUPPLIED BY THE CITY OF MEMPHIS

	Sheahan Station	Allen Station	McCord Station	Mallory Station	Lichterman Station
Before Aeration					
Iron (Fe)	0.53 mg/L*	0.44	0.46	0.43	0.14
Manganese (Mn)	0.012	0.013	0.014	0.013	0.003
Fluoride (F^-)	0.09	0.09	0.09	0.11	0.09
pH	6.5	6.5	6.4	6.4	6.3
After Aeration, Filtration and Fluoridation					
Iron (Fe)	0.03	0.02	0.06	0.03	0.03
Manganese (Mn)	0.001	0.001	0.003	0.001	0.005
Fluoride (F^-)	0.99	1.04	0.99	1.07	0.99
pH	7.3	7.4	7.4	7.4	7.4
Alkalinity ($CaCO_3$)	43.0	66.0	49.0	64.0	37.0
Hardness ($CaCO_3$)	39.0	62.0	44.0	58.0	32.0
Calcium ($CaCO_3$)	19.0	31.5	22.8	27.8	18.0
Magnesium ($CaCO_3$)	20.0	30.5	21.2	30.2	14.0
Sodium (Na)	7.94	9.83	8.40	9.16	7.14
Potassium (K)	0.84	0.93	0.88	0.82	0.72
Sulfate (SO_4)	9.0	9.0	14.3	6.3	6.7
Chloride (Cl)	5.8	6.9	7.1	4.5	6.7
Nitrate (NO_3)	0.10	0.08	0.08	0.26	0.20
Phosphate (PO_4)	1.40	1.34	1.50	1.37	1.34
Dissolved Solids	68.0	104.0	80.0	68.0	66.0
Silica (SiO_2)	13.7	15.2	12.8	14.7	14.0
Temperature at Station (F°)	65.0	63.0	63.0	65.0	63.0

pH is influenced by aeration efficiency which varies slightly with the pumping rate and wind velocity.

* mg/L is equal to parts per million

Analysis (con'd)

ANALYSIS OF WATER SUPPLIED BY THE CITY OF MEMPHIS

	LNG Plant	Davis Station	Morton Station	Palmer Station	Average of All Stations
Before Aeration					
Iron (Fe)	0.75 mg/L*	0.63	0.79	0.07	0.47
Manganese (Mn)	0.012	0.010	0.015	0.007	0.011
Fluoride (F^-)	0.13	0.10	0.10	0.10	0.10
pH	6.3	6.6	6.6	6.3	6.4
After Aeration, Filtration and Fluoridation					
Iron (Fe)	0.02	0.04	0.02	0.01	0.02
Manganese (Mn)	0.017	0.010	0.001	0.001	0.004
Fluoride (F^-)	1.05	1.02	1.02	1.05	1.02
pH	7.3	7.7	7.6	7.3	7.4
Alkalinity($CaCO_3$)	37.0	120.0	57.0	42.0	57.2
Hardness($CaCO_3$)	32.0	110.0	55.0	35.0	51.9
Calcium($CaCO_3$)	17.8	63.5	30.3	17.0	27.5
Magnesium($CaCO_3$)	14.2	46.5	24.7	18.0	24.4
Sodium (Na)	6.92	9.04	6.22	8.43	8.12
Potassium (K)	0.80	1.18	1.24	0.84	0.92
Sulfate (SO_4)	7.5	8.4	7.9	8.1	8.6
Chloride (Cl)	5.2	6.6	4.6	6.5	6.0
Nitrate (NO_3)	0.07	0.16	0.16	0.07	0.13
Phosphate (PO_4)	1.50	1.27	1.59	1.40	1.41
Dissolved Solids	68.0	148.0	68.0	52.0	80.2
Silica (SiO_2)	10.9	14.1	10.0	12.2	13.1
Temperature at Station (F°)	65.0	62.0	64.0	64.0	64.0

pH is influenced by aeration efficiency which varies slightly with the pumping rate and wind velocity.

*mg/L is equal to parts per million

July 1989

J.H. Webb
Manager, Water Laboratory

P.O. Box 430 Memphis, Tennessee 38101 Telephone (901) 528-4011

ADDITIONAL CHARACTERISTICS OF WATER SUPPLIED BY THE CITY OF MEMPHIS

	Sheahan Station	Allen Station	McCord Station	Mallory Station	Lichterman Station
Color (Units-PCS)	<5	<5	<5	<5	<5
Turbidity (NTU)	0.14	0.11	0.18	0.18	0.13
Specific Conductance (Micromhos / cm @25°C	113	160	122	133	94
Aluminum (Al)*	0.006	0.003	0.008	0.029	0.0039
Arsenic (As)	<0.005	<0.005	<0.005	<0.005	<0.005
Barium (Ba)	0.024	0.058	0.034	0.048	0.021
Cadmium (Cd)	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium (Cr)	<0.001	<0.001	<0.001	<0.001	<0.001
Copper (Cu)	0.048	0.035	0.045	0.061	0.053
Cyanide (CN^{-2})	<0.010	<0.010	<0.010	<0.010	<0.010
Detergents (MBAS)	<0.025	<0.025	<0.025	<0.025	<0.025
Lead (Pb)	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury (Hg)	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Phenols	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se)	<0.005	<0.005	<0.005	<0.005	<0.005
Silver (Ag)	<0.001	<0.001	<0.001	<0.001	<0.001
Zinc (Zn)	<0.005	<0.005	<0.005	<0.005	<0.005
Total Coliform (Colonies / 100ml)	<1.0	<1.0	<1.0	<1.0	<1.0
Total Organic Carbon	0.492	0.637	0.501	0.654	0.340
Trihalomethanes	0.002	0.006	0.004	0.004	0.004
Volatile Organic Chemicals	ND	ND	ND	ND	ND

Reference 25

MEMPHIS LIGHT, GAS AND WATER DIVISION

June 28, 1993

Mr. Christian J. Lavalle
B & V Waste Science and Technology Corporation
The Curtis Center, Suite 705
601 Walnut Street
Philadelphia, PA 19106-3307

RE: City of Memphis Water Production

Dear Mr. Lavalle:

In response to your above referenced inquiry, please find enclosed copies of maps containing our well fields (please note the revision date indicated on each map).

The total number of water customers MLGW supplies is 213,311, and each well produces approximately 344 million gallons of water per year.

The information concerning the depths of the wells can be located in the 1990 Production Book you obtained earlier from MLGW; this is the most recent information we have at this time.

If you have further questions, please contact Donna Robbins at (901) 528-4736.

Sincerely,

Paula Payne

Paula Payne
Vice President
Support Services

dr

Enclosures

U.S. Department of Commerce
Economics and Statistics Administration
BUREAU OF THE CENSUS

CENSUS '90

Reference 26

1990 CPH-1-44

1990 Census of Population and Housing

Summary Population and Housing Characteristics

Tennessee

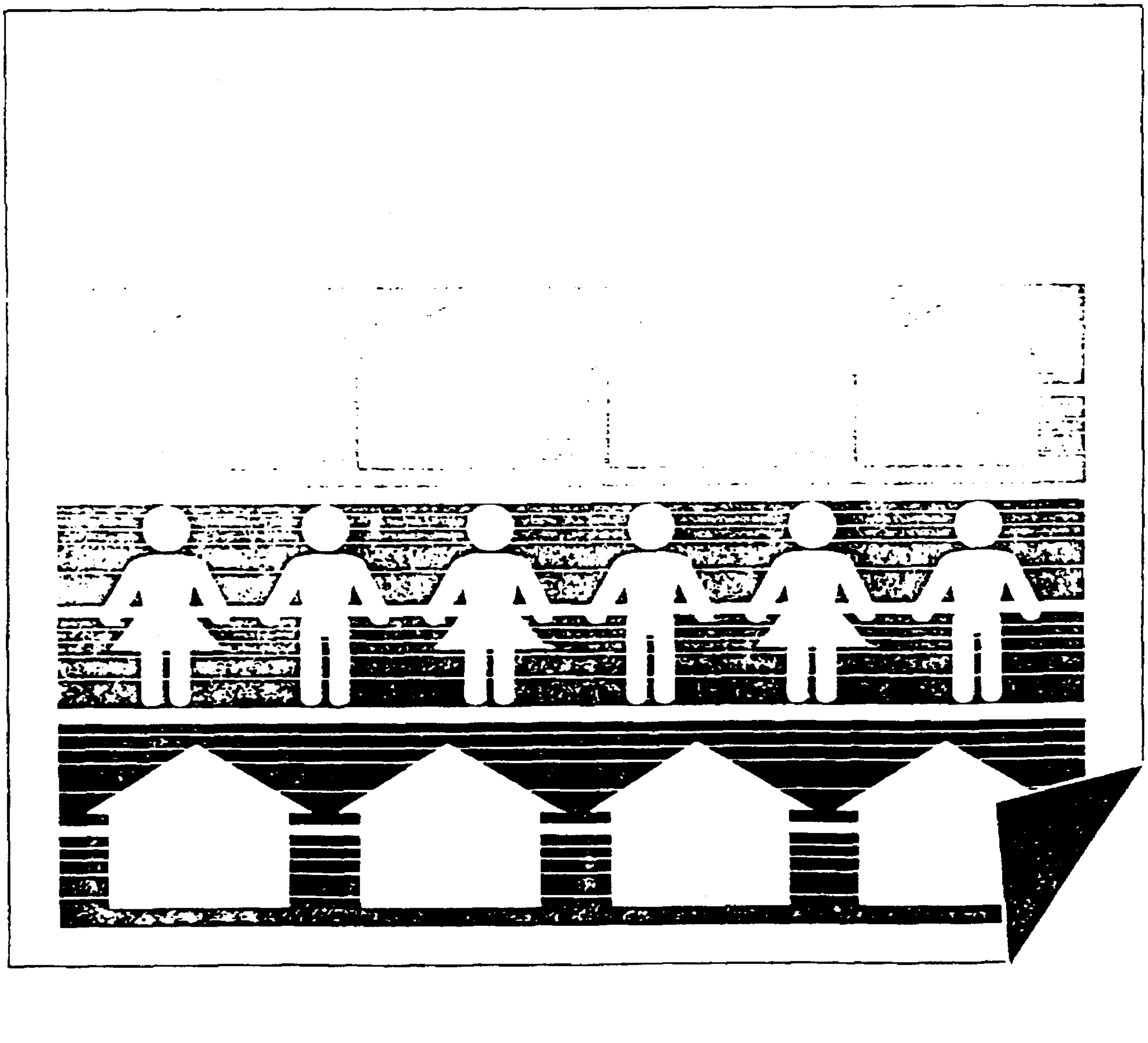


Table 5. Household, Family, and Group Quarters Characteristics: 1990—Con.

[For definitions of terms and meanings of symbols, see text]

State / County / County Subdivision / Place	Persons in households	All households	Family households: Total	Family households: Married-couple family	Family households: Female householder, no husband present	Nonfamily households: Total	Householder living alone: Total	Householder living alone, 65 years and over: Total	Householder living alone, 65 years and over: Female	Persons per—: Household	Persons per—: Family	Persons in group quarters: Total	Persons in group quarters: Institutionalized persons	Persons in group quarters: Other persons in group quarters
Scott County	18 189	6 534	5 128	4 150	765	1 406	1 311	684	553	2 78	3 21	169	69	
Huntsville division	4 928	1 718	1 387	1 134	201	331	296	154	125	2 87	3 25	114	14	
Huntsville town	546	215	148	119	22	67	62	44	37	2 54	3 14	114	14	
Oneida town (pt.)	19	5	4	3	-	1	1	1	1	3 80	4 50	-	-	
Norma division	2 226	719	617	516	75	102	95	49	42	3 10	3 38	-	-	
Oneida division	5 522	2 121	1 568	1 224	275	553	531	290	237	2 60	3 12	55	55	
Oneida town (pt.)	2 977	1 224	826	594	190	398	383	215	183	2 43	3 07	55	55	
Robbins division	2 514	870	694	573	99	176	163	90	70	2 89	3 32	-	-	
Winfield division	2 999	1 106	862	703	115	244	226	101	79	2 71	3 11	-	-	
Oneida town (pt.)	451	196	131	99	26	65	62	17	12	2 30	2 88	-	-	
Winfield town	564	206	161	132	22	45	43	21	17	2 74	3 09	-	-	
Sequatchie County	8 778	3 287	2 555	2 087	353	732	656	322	252	2 67	3 06	85	85	
Center Point division	2 292	851	675	580	65	176	151	65	47	2 69	3 05	-	-	
Dunlap division	6 486	2 436	1 880	1 507	288	556	505	257	205	2 66	3 06	85	85	
Dunlap city	3 646	1 417	1 055	814	191	362	332	173	143	2 57	3 03	85	85	
Sevier County	50 394	19 520	15 091	12 706	1 853	4 429	3 858	1 561	1 239	2 58	2 96	649	582	4
Beech Springs division	4 458	1 677	1 353	1 157	156	324	280	116	88	2 66	2 98	-	-	
Sevierville town (pt.)	252	95	66	54	11	29	23	8	6	2 65	3 18	-	-	
Chilhowee division	8 828	3 185	2 703	2 381	257	482	430	179	149	2 77	3 04	77	77	
Seymour CDP (pt.)	5 027	1 837	1 550	1 356	168	287	255	100	87	2 74	3 01	77	77	
Dunn Creek division	3 966	1 489	1 160	1 012	109	329	283	115	85	2 66	3 05	3	-	
Pittman Center town	475	206	142	123	10	64	58	29	23	2 31	2 81	3	-	
Gatlinburg division	4 335	1 868	1 308	1 071	178	560	487	197	167	2 32	2 78	60	-	
Gatlinburg city	3 357	1 484	1 007	822	139	477	414	170	145	2 26	2 75	60	-	
Knob Creek division	4 256	1 579	1 275	1 091	121	304	262	109	83	2 70	3 03	-	-	
Sevierville town (pt.)	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sevierville division	19 807	7 920	5 871	4 797	861	2 049	1 790	729	577	2 50	2 93	509	505	
Pigeon Forge city (pt.)	2 602	1 075	764	618	121	311	263	93	73	2 42	2 90	113	109	
Sevierville town (pt.)	6 726	2 885	1 961	1 507	382	924	841	382	314	2 33	2 87	200	200	
Wears Valley division	4 744	1 802	1 421	1 197	171	381	326	116	90	2 63	2 98	-	-	
Pigeon Forge city (pt.)	312	120	98	87	10	22	21	6	5	2 60	2 94	-	-	
Shelby County	803 085	303 571	212 076	144 773	56 404	91 495	77 999	25 382	20 245	2 65	3 22	23 245	12 18	11 0
Arlington division	9 012	2 990	2 569	2 198	300	421	372	143	106	3 01	3 29	661	656	
Arlington town	1 052	356	283	234	42	73	66	31	22	2 96	3 37	489	489	
Bartlett town (pt.)	10	5	3	3	-	2	2	1	1	2 00	2 67	167	167	
Lakeland city	1 199	455	381	339	38	74	65	20	17	2 64	2 92	5	-	
Collierville division	17 385	5 448	4 787	4 208	455	661	586	222	176	3 19	3 45	114	114	
Collierville town (pt.)	14 313	4 429	3 879	3 369	406	550	489	192	155	3 23	3 50	114	114	
Memphis city (pt.)	-	-	-	-	-	-	-	-	-	-	-	-	-	
Fisherville division	3 653	1 192	1 025	913	77	167	153	76	56	3 06	3 37	5	-	
Memphis division	742 676	283 879	195 259	130 489	54 422	88 620	75 529	24 481	19 558	2 62	3 21	16 627	11 181	5 44
Bartlett town (pt.)	26 627	8 451	7 636	6 764	666	815	711	222	189	3 15	3 34	185	185	
Collierville town (pt.)	-	-	-	-	-	-	-	-	-	-	-	-	-	
Germantown city	32 893	10 713	9 414	8 620	634	1 299	1 167	281	233	3 07	3 33	-	-	
Memphis city (pt.)	594 322	229 829	153 785	94 315	50 316	76 044	64 964	27 700	18 122	2 59	3 21	16 015	10 569	5 44
Millington division	20 776	7 002	5 772	4 829	735	1 230	1 013	314	242	2 97	3 29	5 819	229	5 59
Memphis city (pt.)	-	-	-	-	-	-	-	-	-	-	-	-	-	
Millington city	12 225	4 168	3 412	2 911	387	756	606	152	115	2 93	3 27	5 64	5	5 59
Rosemark division	1 788	636	533	478	38	103	94	52	42	2 81	3 11	-	-	
Shelby Forest division	7 845	2 424	2 131	1 658	377	293	252	94	65	3 24	3 46	19	-	1
Memphis city (pt.)	-	-	-	-	-	-	-	-	-	-	-	-	-	
Smith County	13 998	5 358	4 151	3 579	447	1 207	1 127	643	512	2 61	3 03	145	134	1
Carthage division	5 921	2 353	1 725	1 465	210	628	591	353	299	2 52	3 02	145	134	1
Carthage town	2 241	993	626	477	131	361	350	203	180	2 26	2 94	145	134	1
Forks of the River division	1 657	619	494	434	32	125	116	65	43	2 68	3 06	-	-	
South Carthage division	6 420	2 386	1 932	1 680	205	454	420	225	170	2 69	3 04	-	-	
Gordonsville town	891	347	276	220	49	71	67	42	33	2 57	2 95	-	-	
South Carthage town	851	343	252	205	42	91	89	44	34	2 48	2 96	-	-	
Stewart County	9 295	3 678	2 812	2 452	251	866	793	444	344	2 53	2 93	184	95	8
Cumberland City-Cerulean division	1 776	705	537	453	56	168	156	71	52	2 52	2 93	-	-	
Cumberland City town	319	131	97	72	17	34	30	12	7	2 44	2 84	-	-	
Dover division	3 021	1 244	900	788	83	344	321	192	157	2 43	2 90	98	95	
Dover city	1 246	564	365	309	45	199	188	123	105	2 21	2 78	95	95	
Indian Mound-Bumpus Mills division	4 498	1 729	1 375	1 211	112	354	316	181	135	2 60	2 94	-	-	
Model division	-	-	-	-	-	-	-	-	-	-	-	86	-	8
Sullivan County	141 449	56 729	42 516	35 372	5 632	14 213	13 048	5 674	4 669	2 49	2 93	2 147	1 351	79
Blountville division	13 846	5 246	4 166	3 600	412	1 080	955	354	276	2 64	3 01	485	464	2
Blountville CDP	2 296	879	712	610	73	167	154	86	72	2 61	2 95	309	309	
Bristol city (pt.)	76	31	20	17	3	11	7	1	1	2 45	3 05	-	-	
Kingsport city (pt.)	2	1	1	-	1	-	-	-	-	2 00	2 00	-	-	
Walnut Hill CDP (pt.)	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bluff City-Piney Flats division	16 483	6 212	4 990	4 252	530	1 222	1 115	469	368	2 65	3 00	11	10	1
Bluff City city	1 390	544	414	330	57	130	121	57	51	2 56	2 97	-	-	
Bristol city (pt.)	79	32	24	18	5	8	7	6	5	2 47	2 92	-	-	
Johnson City city (pt.)	96	37	27	24	1	10	6	3	3	2 59	3 00	-	-	
Bristol division	29 434	12 191	8 622	6 965	1 315	3 569	3 258	1 397	1 140	2 41	2 93	715	266	449
Bristol city (pt.)	22 707	9 682	6 565	5 213	1 092	3 117	2 851	1 253	1 025	2 35	2 91	559	119	440
Walnut Hill CDP (pt.)	3 332	1 247	1 024	881	108	218	198	80	64	2 68	2 99	-	-	
Holston Valley division	2 721	987	812	679	94	175	160	74	58	2 76	3 06	234	-	234
Bristol city (pt.)	-	-	-	-	-	-	-	-	-	-	-	-	-	
Kingsport division	78 965	32 093	23 926	19 876	3 281	8 167	7 560	3 380	2 827	2 46	2 91	702	61	9
Bloomingdale CDP	10 953	4 232	3 345	2 815	423	887	788	292	239	2 59	2 95	-	-	
Colonial Heights CDP	6 711	2 538	2 080	1 868	164	458	418	143	120	2 64	2 96	5	-	5
Kingsport city (pt.)	33 510	14 692	9 983	7 830	1 828	4 709	4 419	2 186	1 865	2 28	2 83	649	589	6
Spurgeon CDP (pt.)	1 331	523	410	358	45	113	109	47	35	2 54	2 95	-	-	
Sumner County	102 065	36 850	29 511	24 907	3 545	7 339	6 384	2 579	2 093	2 77	3 13	1 216	637	57
Bethpage division	3 073	1 078	899	784	75	179	154	71	52	2 85	3 15	21	-	21
Gallatin city (pt.)	411	132	122	112	4	10	9	3	2	3 11	3 22	-	-	-
Castalian Springs division	3 615	1 232	1 081	953	89	151	128	43	29	2 93	3 15	7	-	7
Gallatin city (pt.)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gallatin division	21 617	8 224	6 120	4 688	1 151	2 104	1 845	854	729	2 63	3 09	552	393	15
Gallatin city (pt.)	17 761	6 872	5 002	3 724	1 036	1 870	1 644	777	666	2 58	3 07	552	393	15

Reference 27

U.S. Department of Commerce
Economics and Statistics Administration
BUREAU OF THE CENSUS

CENSUS '90

1990 CP-1-5

1990 Census of Population

General Population Characteristics

Arkansas

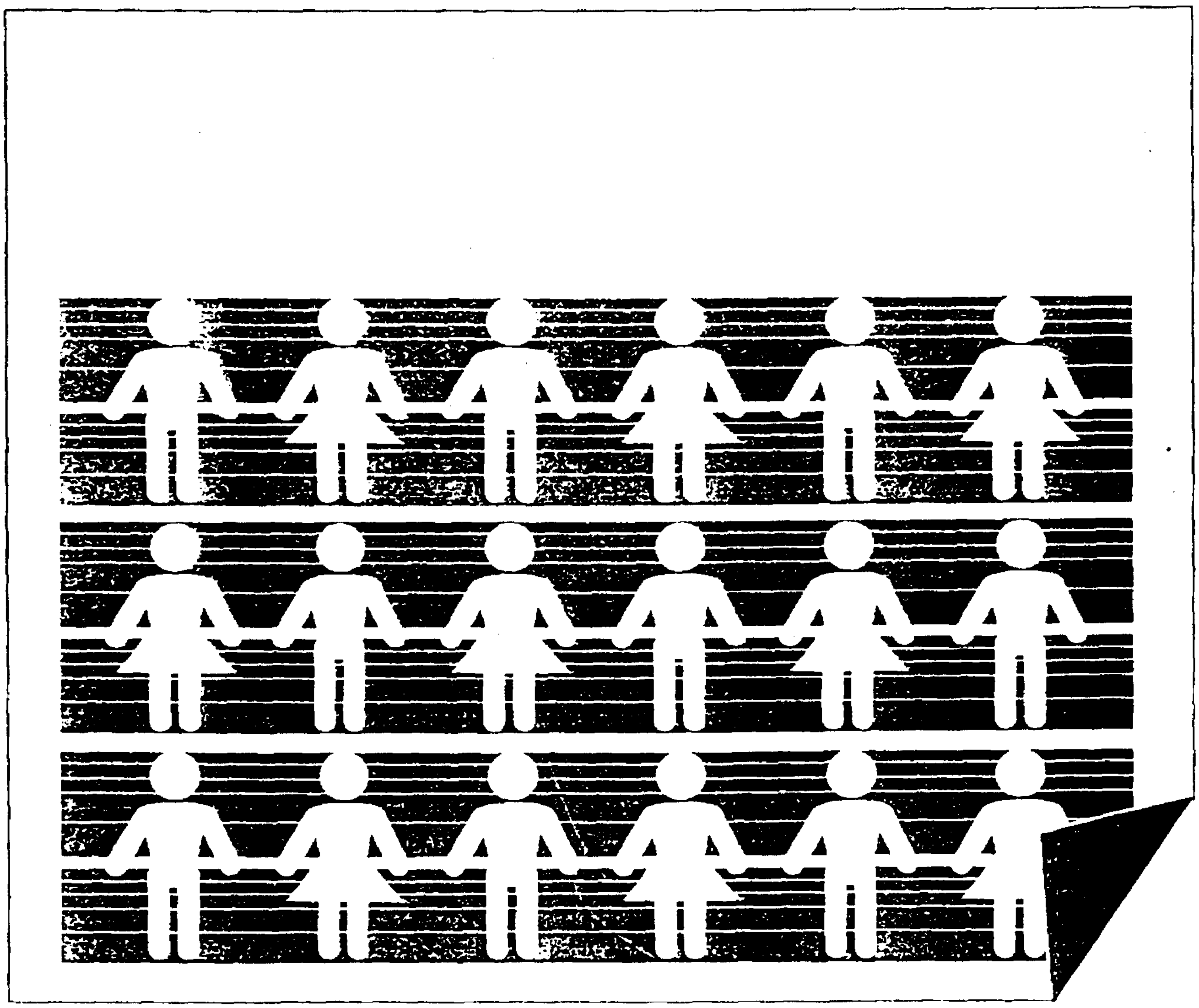


Table 2. Summary of General Characteristics of Households and Families: 1990

[For definitions of terms and meanings of symbols, see text]

State Urban and Rural and Size of Place Inside and Outside Metropolitan Area County Place and [In Selected States] County Subdivision [1,000 or More Persons]	All households	Percent of all households: Family households: Total	Family households: With own children under 18 years	Married-couple family: Total	Married-couple family: With own children under 18 years	Female householder, no husband present: Total	Female householder, no husband present: With own children under 18 years	Nonfamily households: Total	Householder living alone: Total	Householder living alone: Female	65 years and over: Total	65 years and over: Female	Householder 65 years and over	Persons per — Household	Persons per — Family
The State	891 179	73.1	34.3	59.2	26.5	11.1	6.5	26.9	24.0	15.0	11.6	9.2	25.9	2.57	3.06
URBAN AND RURAL AND SIZE OF PLACE															
Urban	488 323	68.9	32.9	52.7	23.3	13.5	8.3	31.1	27.4	17.6	12.4	10.1	25.7	2.48	3.04
Inside urbanized area	230 144	67.7	33.3	50.9	23.5	13.9	8.5	32.3	27.8	17.0	10.2	8.3	21.1	2.50	3.08
Central place	204 836	66.3	32.2	49.4	22.3	14.1	8.5	33.7	28.9	17.7	10.6	8.6	21.7	2.46	3.07
Urban fringe	25 308	78.4	42.4	63.4	33.2	12.1	7.7	21.6	18.9	11.3	7.0	5.7	16.4	2.76	3.16
Outside urbanized area	258 179	70.0	32.5	54.2	23.2	13.2	8.1	30.0	27.0	18.2	14.4	11.8	29.7	2.47	[illegible]
Place of 10,000 or more	122 793	68.4	32.4	53.1	23.4	12.7	7.8	31.6	27.5	18.0	13.2	10.9	26.7	2.45	3.01
Place of 2,500 to 9,999	135 386	71.4	32.7	55.3	22.9	13.6	8.5	28.6	26.5	18.3	15.4	12.5	32.5	2.49	3.01
Rural	402 856	78.2	36.1	67.1	30.3	8.2	4.4	21.8	19.9	11.8	10.6	8.0	26.2	2.68	3.08
Place of 1,000 to 2,499	52 349	71.1	32.1	56.2	23.6	12.3	7.3	28.9	27.1	19.2	16.9	13.8	34.5	2.48	3.01
Place of less than 1,000	42 101	73.0	33.6	58.4	26.0	11.4	6.2	27.0	25.3	16.6	15.5	12.2	32.4	2.59	3.10
Other rural	308 406	80.1	37.1	70.1	32.0	7.1	3.7	19.9	17.9	9.9	8.9	6.4	23.9	2.73	3.09
INSIDE AND OUTSIDE METROPOLITAN AREA															
Inside metropolitan area	354 752	71.6	35.4	56.7	26.8	12.0	7.2	28.4	24.4	14.7	9.6	7.7	20.9	2.59	3.11
In central city	204 520	66.3	32.1	49.3	22.3	14.1	8.6	33.7	28.9	17.7	10.6	8.6	21.7	2.46	3.07
Not in central city	150 232	78.9	39.9	66.7	32.9	9.2	5.4	21.1	18.4	10.7	8.2	6.4	19.7	2.76	3.15
Urban	58 137	75.8	39.9	61.7	31.2	11.4	7.3	24.2	20.7	13.1	8.9	7.4	19.6	2.68	3.12
Inside urbanized area	25 298	78.4	42.4	63.4	33.2	12.1	7.7	21.6	18.9	11.3	7.0	5.7	16.4	2.76	3.16
Outside urbanized area	32 839	73.7	37.9	60.4	29.7	10.9	7.0	26.3	22.1	14.4	10.4	8.6	22.0	2.62	3.08
Rural	92 095	80.9	39.9	69.9	34.0	7.9	4.3	19.1	16.9	9.3	7.7	5.8	19.9	2.80	3.16
Outside metropolitan area	536 427	74.1	33.6	60.8	26.2	10.5	6.1	25.9	23.7	15.1	12.9	10.2	29.2	2.56	3.04
Urban	225 666	69.5	31.8	53.4	22.2	13.5	8.3	30.5	27.7	18.7	14.9	12.2	30.8	2.45	3.00
Inside urbanized area	326	88.3	42.9	78.8	38.7	5.8	2.5	11.7	11.3	6.7	4.0	3.7	11.7	2.87	3.07
Outside urbanized area	225 340	69.5	31.8	53.3	22.2	13.5	8.3	30.5	27.7	18.7	14.9	12.2	30.9	2.45	3.00
Place of 10,000 or more	106 363	68.4	32.3	52.6	23.1	13.1	8.0	31.6	28.0	18.3	13.5	11.2	27.2	2.44	3.01
Place of 2,500 to 9,999	118 977	70.4	31.3	54.0	21.5	13.9	8.6	29.6	27.4	19.1	16.2	13.2	34.1	2.46	2.99
Rural	310 761	77.4	34.9	66.2	29.1	8.3	4.4	22.6	20.8	12.5	11.5	8.7	28.0	2.64	3.06
COUNTY															
Arkansas County	8 389	72.1	34.8	56.9	25.8	12.1	7.4	27.9	25.8	16.2	13.9	11.0	28.5	2.54	3.06
Ashley County	8 890	76.7	37.0	61.7	28.7	11.9	6.7	23.3	21.9	13.5	11.8	9.6	26.4	2.70	3.16
Baxter County	13 486	73.5	23.8	65.4	19.3	6.1	3.4	26.5	24.5	16.5	15.9	12.0	42.8	2.28	2.69
Benton County	37 555	77.2	32.5	67.9	27.2	6.9	4.1	22.8	20.0	12.7	10.0	8.2	29.0	2.55	2.93
Boone County	11 131	74.4	33.3	64.2	27.5	7.9	4.6	25.6	23.2	15.6	12.8	10.2	28.6	2.50	2.95
Bradley County	4 545	73.3	32.6	57.0	23.7	13.3	7.5	26.7	25.2	16.8	15.0	12.3	32.5	2.54	3.03
Calhoun County	2 185	74.0	33.7	60.9	27.1	10.5	5.6	26.0	24.0	14.4	13.8	10.7	29.8	2.63	3.13
Carroll County	7 550	72.0	30.4	61.0	24.4	8.4	4.6	28.0	24.4	15.6	12.4	9.7	29.7	2.45	2.92
Chicot County	5 557	71.2	34.7	45.8	20.1	21.7	13.2	28.8	26.8	17.8	16.5	12.8	32.6	2.81	3.44
Clark County	7 907	69.3	30.8	55.7	22.9	11.2	6.9	30.7	27.4	17.9	14.6	11.7	30.1	2.42	2.96
Clay County	7 504	71.7	29.8	61.4	24.8	7.7	3.8	28.3	26.5	18.0	16.4	13.1	34.1	2.38	2.87
Cleburne County	7 926	76.0	28.2	67.2	23.4	6.7	3.7	24.0	22.0	14.1	12.4	9.4	32.7	2.41	2.80
Cleveland County	2 868	79.0	37.3	66.7	30.7	9.5	5.3	21.0	19.5	12.2	12.2	9.5	26.7	2.69	3.09
Columbia County	9 638	71.1	32.7	54.4	24.0	13.8	7.5	28.9	26.8	17.4	15.3	12.0	30.7	2.57	3.13
Conway County	7 179	74.6	33.5	60.8	26.2	10.9	5.9	25.4	23.5	14.8	13.3	10.5	29.3	2.62	3.10
Craighead County	26 285	71.8	34.8	58.7	27.4	10.5	6.3	28.2	23.5	14.7	9.7	8.2	20.8	2.53	3.01
Crawford County	15 251	80.2	41.0	67.6	33.3	9.9	6.4	19.8	17.9	11.2	8.9	7.2	21.2	2.75	3.12
Crittenden County	17 120	75.8	39.7	53.1	26.5	18.7	11.3	24.2	21.3	12.4	9.2	6.9	20.8	2.89	3.39
Cross County	6 754	77.6	39.8	61.2	30.3	12.8	7.5	22.4	20.8	13.9	11.4	9.2	26.4	2.81	3.25
Dallas County	3 600	72.9	32.9	57.4	25.4	11.6	5.9	27.1	25.3	15.7	15.1	11.3	31.5	2.61	3.14
Desha County	5 957	73.6	38.2	52.8	25.9	17.5	10.8	26.4	24.3	15.7	14.1	10.9	28.6	2.78	3.34
Drew County	6 342	74.1	37.6	57.4	27.8	13.6	8.4	25.9	23.7	14.7	12.1	9.4	25.4	2.63	3.12
Faulkner County	21 325	73.8	37.0	62.1	30.2	9.3	5.5	26.2	20.5	12.2	8.5	6.9	19.5	2.65	3.10
Franklin County	5 578	76.2	35.2	65.3	29.3	8.0	4.5	23.8	22.2	14.1	12.7	9.9	28.8	2.58	3.03
Fulton County	4 010	75.3	30.9	65.8	26.1	7.0	3.7	24.7	23.3	15.4	14.5	11.1	35.0	2.47	2.90
Garland County	30 836	69.4	26.5	57.5	20.0	9.5	5.4	30.6	27.6	17.5	14.7	11.2	34.3	2.32	2.82
Grant County	5 118	79.4	38.9	69.1	33.5	7.2	3.8	20.6	19.1	11.9	10.4	8.3	23.1	2.70	3.09
Greene County	12 325	75.8	34.9	64.7	28.9	8.5	4.7	24.2	22.0	14.3	11.9	9.7	26.2	2.54	2.97
Hempstead County	8 212	73.1	34.8	56.6	25.6	13.4	7.8	26.9	25.0	15.8	13.4	10.6	28.8	2.58	3.09
Hot Spring County	10 115	75.5	34.3	62.6	27.0	10.0	5.9	24.5	23.2	15.0	12.8	10.1	28.9	2.55	3.00
Howard County	4 975	75.1	36.0	60.6	28.1	11.5	6.7	24.9	23.4	15.3	13.9	10.7	29.7	2.65	3.13
Independence County	11 846	75.1	35.9	64.0	29.8	8.2	4.7	24.9	22.8	14.7	11.9	9.3	25.8	2.58	3.03
Izard County	4 684	74.4	27.0	65.4	22.7	6.9	3.4	25.6	24.2	16.2	16.2	12.4	40.0	2.37	2.80
Jackson County	7 361	73.0	32.7	57.8	25.1	12.2	6.3	27.0	25.0	16.1	14.1	10.9	30.1	2.54	3.04
Jefferson County	30 001	73.2	35.9	54.0	24.9	16.0	9.6	26.8	24.2	14.7	11.8	9.0	25.6	2.70	3.24
Johnson County	7 059	72.8	32.8	61.3	26.4	8.6	[illegible]	27.2	24.4	15.7	14.0	10.9	29.8	2.50	2.98
Lafayette County	3 584	72.2	31.8	55.1	23.8	13.9	6.7	27.8	26.6	16.7	15.9	12.8	33.5	2.66	3.23
Lawrence County	6 857	73.5	32.7	61.9	26.5	9.3	5.1	26.5	24.9	17.2	14.9	11.9	32.0	2.49	2.96
Lee County	4 578	72.7	36.3	49.0	21.8	20.1	12.9	27.3	25.6	15.4	14.4	10.8	30.9	2.82	3.43
Lincoln County	3 796	75.1	36.9	58.2	27.8	14.0	7.7	24.9	23.4	14.5	12.8	9.9	28.2	2.76	3.29
Little River County	5 150	76.3	37.3	61.4	28.9	11.5	6.9	23.7	22.1	13.4	11.7	8.9	25.4	2.68	3.15
Logan County	7 628	74.9	35.0	63.6	28.6	8.6	5.0	25.1	23.6	15.2	14.2	11.3	30.5	2.60	3.09
Lonoke County	13 866	79.5	42.0	67.2	34.7	9.4	5.8	20.5	18.5	11.5	9.7	7.8	21.2	2.80	3.19
Madison County	4 392	77.2	35.0	68.2	30.3	6.2	3.4	22.8	20.7	13.2	12.0	9.4	28.8	2.63	3.04
Marion County	4 970	74.7	27.5	65.4	22.4	6.8	4.0	25.3	23.3	14.2	14.6	10.1	35.9	2.40	2.80
Miller County	14 273	74.0	36.3	55.7	25.9	14.9	[illegible]	26.0	23.7	15.1	11.5	9.2	25.2	2.64	3.14
Mississippi County	20 420	75.3	40.7	56.7	29.5	15.3	9.6	[illegible]	22.4	13.7	11.0	8.7	22.8	2.76	3.26
Monroe County	4 361	69.7	32.6	50.9	21.9	15.8	9.5	30.3	28.7	18.7	16.6	12.7	33.0	2.57	3.19
Montgomery County	3 062	75.0	30.7	65.3	25.7	6.9	3.7	25.0	23.2	14.3	13.2	9.6	32.2	2.46	2.90
Nevada County	3 798	72.7	34.4	57.7	26.7	12.3	6.3	[illegible]	26.0	16.4	15.2	11.8	31.9	2.60	3.15

Reference 28

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
B-202 CLIFFORD DAVIS FEDERAL BUILDING
167 N. MID-AMERICA MALL
MEMPHIS, TENNESSEE 38103-1894

Reply to Attention of:

April 1, 1992

Engineering Division
Hydraulics and Hydrology Branch

Ms. Laura J. Morrisson, Project Scientist
B & V Waste Science & Technology Corporation
1117 Perimeter Center West, Suite W-212
Atlanta, Georgia 30338

Dear Ms. Morrisson:

Reference is made to your letter dated March 25, 1992, and follow-up telephone conversation with Ms. Jancie Hatcher on March 31, 1992, inquiring about water flow information in the Memphis, Tennessee, area.

Please find enclosed the following discharge data for 1990 at Corps of Engineers' gaging locations:

a. Mississippi River at Memphis, Tennessee, River Mile 734.4
b. Loosahatchie River at Brunswick, Tennessee, River Mile 25.3
c. Wolf River at Raleigh, Tennessee, River Mile 9.4

Also enclosed are discharge data for USGS gaging locations from October, 1989, to September, 1990:

a. Nonconnah Creek near Germantown, Tennessee, River Mile 17.3
b. Wolf River at Walnut Grove Road at Memphis, Tennessee, River Mile 15.4
c. Loosahatchie River near Arlington, Tennessee, River Mile 30.4

If we can be of further assistance, please feel free to contact us.

Sincerely,

Dewey L. Jones
Chief, Hydraulics and Hydrology Branch

Enclosures

07031660 WOLF RIVER AT WALNUT GROVE ROAD AT MEMPHIS, TN

LOCATION.--Lat 35°07'58", long 89°51'18", Shelby County, Hydrologic Unit 08010210, on right bank at upstream end of bridge on Walnut Grove Road, 0.5 mi east of Interstate Highway 240, and at mile 15.4.

DRAINAGE AREA.--709 mi^2.

PERIOD OF RECORD.--October 1969 to current year. Prior to September 1977 published as "near Germantown" and Oct. 1978 to Sept. 1986 "at Germantown".

GAGE.--Water-stage recorder. Datum of gage is 225.82 ft above National Geodetic Vertical Datum of 1929. Prior to Apr. 21, 1986 water-stage recorder at site 2.1 mi upstream at datum 9.94 ft higher.

REMARKS.--Records poor. Periodic observations of water temperature and specific conductance are published in this report as miscellaneous water quality data.

AVERAGE DISCHARGE.--21 years, 1,023 ft^3/s, 19.59 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 33,400 ft^3/s, Mar. 14, 1975, gage height, 27.98 ft, site and datum then in use; minimum, 184 ft^3/s, Oct. 8, 9, 12, 13, 1987.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 7,000 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Feb. 5	Unknown	*19,800	*22.92	May 20	1245	7,160	14.78

Minimum discharge, 251 ft^3/s, Sept. 1-3.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990 MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	956	377	495	e2400	1870	721	750	e4100	700	392	291	253
2	951	377	470	e2130	5090	690	697	e4000	e670	386	282	251
3	807	370	456	e1700	e8430	699	654	3710	e680	372	284	271
4	710	373	439	1960	e11600	691	618	3440	e830	363	280	259
5	724	383	430	e1510	e17300	661	609	3120	e1100	338	282	261
6	757	405	440	e1410	13300	664	1210	2750	e930	315	282	257
7	687	405	417	e1310	6690	762	1120	1990	e850	317	280	257
8	583	1850	411	e1220	3990	4710	943	1290	e690	320	277	262
9	514	1040	425	1020	2970	3510	745	887	e590	319	274	265
10	469	1030	445	882	5760	3730	697	725	e570	323	273	266
11	440	935	443	761	6620	3060	700	624	e550	347	271	283
12	421	740	433	637	6460	2460	667	612	e540	597	268	e410
13	412	599	442	e586	4380	1930	603	611	e530	432	337	406
14	407	556	452	540	2910	1490	573	633	e522	472	318	328
15	403	564	439	533	4020	3840	562	611	e520	448	329	324
16	991	537	430	518	4290	2390	561	617	e610	399	319	327
17	2810	594	403	623	3240	2440	1080	788	e620	374	318	326
18	1370	627	389	1120	2200	2820	1300	806	e550	349	309	316
19	1070	e550	410	1020	1540	2620	1170	911	e530	343	299	308
20	824	e460	406	1140	1010	1860	903	5220	e520	334	289	309
21	681	e445	e399	1110	804	1270	2730	4020	e522	321	283	318
22	631	e890	e391	1100	1520	906	2360	4790	e560	355	277	338
23	611	e899	e392	900	1520	744	2610	4730	e580	378	271	343
24	556	e740	e397	800	1420	651	2470	3940	e550	384	266	344
25	496	e770	e389	733	1270	606	2200	3160	e490	411	261	350
26	447	e690	e395	e872	1060	581	e1600	2430	e470	378	258	370
27	e425	e640	e385	600	925	578	e1780	1710	e460	352	257	397
28	e415	e610	e397	e802	791	578	e2600	1250	438	337	257	388
29	e405	595	471	e3780	---	585	e3350	981	422	321	257	329
30	e390	532	e2200	e2440	---	1510	e4000	718	404	315	258	316
31	387	---	e2250	e2460	---	974	---	685	---	296	256	---
TOTAL	21752	19683	16753	38417	123180	50731	41862	65839	17998	11388	8761	9432
MEAN	702	656	540	1239	4399	1636	1395	2124	600	367	283	314
MAX	2810	1950	2250	3780	17300	4710	4000	5220	1100	597	337	410
MIN	387	370	389	518	791	578	561	611	404	296	256	251
CFSM	.99	.93	.76	1.75	6.20	2.31	1.97	3.00	.85	.52	.40	.44
IN.	1.14	1.03	.88	2.02	6.46	2.66	2.20	3.45	.94	.60	.46	.49

CAL YR 1989 TOTAL 560214 MEAN 1535 MAX 14900 MIN 350 CFSM 2.16 IN. 29.39
WTR YR 1990 TOTAL 425796 MEAN 1167 MAX 17300 MIN 251 CFSM 1.65 IN. 22.34

e Estimated

2

07030240 LOOSAHATCHIE RIVER NEAR ARLINGTON, TN

LOCATION.--Lat 35°18'37", long 89°38'23", Shelby County, Hydrologic Unit 08010209, on left bank 20 ft downstream from bridge on U.S. Highways 70 and 79, 1.5 mi upstream from Beaver Creek, 1.5 mi northeast of Arlington, and at mile 30.4.

DRAINAGE AREA.--262 mi^2.

PERIOD OF RECORD.--October 1969 to current year.

GAGE.--Water-stage recorder. Datum of the gage is 246.43 ft above National Geodetic Vertical Datum of 1929.

REMARKS.--Records poor. Periodic observations of water temperature and specific conductance are published in this report as miscellaneous water quality data.

AVERAGE DISCHARGE.--21 years, 378 ft^3/s, 19.59 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 27,400 ft^3/s, Dec. 25, 1987, gage height, 25.27 ft; minimum, 66 ft^3/s, Apr. 6, 7, 1974.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 5,500 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Nov. 8	0900	6,850	17.15	Feb. 15	2400	6,330	16.52
Jan. 29	Unknown	Unknown	Unknown	Mar. 8	1200	7,360	17.66
Feb. 4	Unknown	*14,500	*22.11	Apr. 21	1315	5,540	17.59
Feb. 10	Unknown	Unknown	Unknown				

Minimum discharge, 97 ft^3/s, several days.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	534	126	115	486	273	353	172	235	e150	107	101	97
2	225	124	115	232	5400	360	168	1660	e150	105	101	97
3	163	123	111	197	8900	348	163	951	e400	105	101	97
4	146	123	110	1120	e12000	328	140	498	e220	103	101	98
5	141	123	110	403	e2350	316	134	190	e170	100	101	98
6	137	138	110	216	820	312	228	173	e145	100	101	98
7	134	304	114	172	634	320	232	170	e140	100	101	98
8	131	5320	114	169	564	4840	159	168	e135	99	101	98
9	130	2200	112	157	947	2810	146	155	e132	99	101	98
10	128	399	110	141	e6700	599	152	143	e129	99	101	102
11	126	211	108	132	e2330	306	179	147	e128	103	101	129
12	125	176	106	125	732	508	151	175	e127	140	101	108
13	124	164	105	117	545	687	140	163	e125	157	102	102
14	124	159	104	116	456	271	138	141	e122	117	102	100
15	123	169	103	115	2900	3340	138	139	e121	108	102	103
16	304	182	100	113	4650	1550	138	138	e120	106	102	100
17	2310	152	100	302	e1100	427	1140	185	e119	104	102	98
18	343	142	100	943	576	296	791	170	e118	103	102	98
19	199	137	100	380	493	243	241	193	e117	104	102	98
20	170	136	101	500	426	211	188	e3570	e116	104	102	98
21	154	133	100	323	396	198	3520	e1600	e114	103	101	99
22	148	327	97	185	1720	189	3140	e700	e160	103	100	100
23	141	490	97	152	856	182	526	e400	e130	103	100	99
24	138	192	97	137	515	175	246	e250	e119	102	100	97
25	134	153	97	144	409	170	203	217	e112	102	99	97
26	131	140	99	126	375	165	181	193	e112	102	99	97
27	130	133	99	114	362	160	326	187	e111	102	99	97
28	128	127	98	346	352	158	5370	182	e110	102	99	97
29	127	119	105	e3910	---	163	2580	162	109	102	98	97
30	127	117	698	e1310	---	754	396	161	108	102	98	97
31	127	---	2180	392	---	278	---	e143	---	102	97	---
TOTAL	7300	12539	5915	13275	57781	21027	21426	13559	4169	3288	3118	2992
MEAN	235	418	191	428	2064	678	714	437	139	106	101	99.7
MAX	2310	5320	2180	3910	12000	4840	5370	3570	400	157	102	129
MIN	123	117	97	113	273	158	134	138	108	99	97	97
CFSM	.90	1.60	.73	1.63	7.88	2.59	2.73	1.67	.53	.40	.38	.38
IN.	1.04	1.78	.84	1.88	8.20	2.99	3.04	1.93	.59	.47	.44	.42

CAL YR 1989 TOTAL 227119 MEAN 622 MAX 13000 MIN 84 CFSM 2.37 IN. 32.25
WTR YR 1990 TOTAL 166389 MEAN 456 MAX 12000 MIN 97 CFSM 1.74 IN. 23.62

e Estimated

3

DAILY DISCHARGE FOR 1990

MISSISSIPPI RIVER AT MEMPHIS, TENN.

COMPUTED DAILY DISCHARGE IN THOUSAND CUBIC FEET PER SECOND

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	196	601	1120	666	539	1113	669	452	409	258	435	325
2	203	621	1102	643	517	1106	654	422	408	249	422	336
3	222	664	1068	618	497	1103	635	406	407	240	394	358
4	270	715	1010	585	482	1104	614	409	401	238	357	372
5	349	766	922	557	483	1103	592	415	392	230	322	383
6	443	830	814	534	496	1101	577	406	379	225	293	406
7	527	885	722	503	511	1094	560	398	368	227	279	451
8	611	928	683	481	541	1081	542	395	363	240	272	503
9	642	963	676	464	601	1060	524	395	366	252	273	536
10	658	992	645	452	655	1036	514	402	362	260	276	550
11	661	1003	609	439	685	1010	510	410	352	263	275	551
12	648	1009	592	433	685	979	511	413	350	269	279	540
13	619	1015	580	444	664	947	507	406	352	286	285	519
14	580	1017	572	466	633	908	504	389	341	301	299	482
15	537	1029	585	487	611	869	509	375	321	311	319	444
16	504	1052	607	507	604	832	516	364	307	312	337	407
17	485	1066	623	525	618	794	521	352	303	321	347	380
18	471	1081	634	552	660	743	533	340	300	343	354	386
19	445	1103	723	564	743	688	555	334	293	371	351	398
20	418	1125	796	573	850	651	574	326	288	396	344	438
21	403	1141	852	573	933	649	582	318	283	410	333	574
22	428	1154	888	556	990	670	587	316	281	411	315	705
23	483	1155	917	532	1037	676	587	323	285	400	298	812
24	539	1150	925	514	1074	674	577	341	287	392	290	911
25	585	1142	923	516	1102	673	561	365	281	393	286	972
26	614	1134	912	527	1116	679	543	389	273	401	289	1021
27	625	1126	885	535	1121	682	534	411	268	413	298	1078
28	627	1124	841	552	1120	688	533	423	268	422	315	1131
29	634		778	566	1118	689	527	428	267	427	320	1166
30	630		722	560	1116	680	510	429	264	429	321	1198
31	615		691		1112		484	423		433		1232
MEAN	505	985	788	530	771	869	553	386	327	326	319	631
MAX	661	1155	1120	666	1121	1113	669	452	409	433	435	1232
MIN	196	601	572	433	482	649	484	316	264	225	272	325

TOTAL DISCHARGE FOR YEAR WAS 211827 MEAN DISCHARGE FOR YEAR WAS 580

MAXIMUM DISCHARGE WAS 1,242,243 CFS ON DEC. 31.
MINIMUM DISCHARGE WAS 194,180 CFS ON JAN. 1.

4

MISSISSIPPI RIVER AT MEMPHIS, TENN.

LOCATION. LAT. 35-07-23, LONG. 90-04-36. MILE 734.4. APPROXIMATELY EIGHTEEN HUNDRED FEET DOWNSTREAM FROM HARAHAN BRIDGE.

GAGE. AUTOMATIC RECORDER ON SOUTHWEST CORNER OF AMERICAN COMMERCIAL LIQUID TERMINAL OIL DOCK AT 427 WEST ILLINOIS AVENUE.

GENERAL INFORMATION. DRAINAGE AREA (REVISED), 928,700 SQUARE MILES. BANKFULL STAGE, 34 FEET. LOW WATER REFERENCE PLANE, MINUS 2.6 FEET ON GAGE. THE AVERAGE RELATION BETWEEN BEALE STREET GAGE AND GAGE NEAR BRIDGE IS A STRAIGHT LINE YIELDING STAGES ON THE BRIDGE GAGE THE SAME AT ZERO STAGE, AND 1.6 FEET LOWER AT THE 50 FOOT STAGE.

RECORDS AVAILABLE. STAGE, OCT. 1934 TO SEPT. 1951 AND OCT. 1952 TO DATE IN REPORTS OF U.S. GEOLOGICAL SURVEY. DEC. 1934 TO DATE IN REPORTS OF THE NATIONAL WEATHER SERVICE. (WEATHER SERVICE STAGES FROM DEC. 1890 TO AUG. 1932 REFER TO BEALE ST. GAGE, AND FROM SEPT. 1932 TO DEC. 1934 TO GAGE AT SITE 1,000 FEET DOWNSTREAM.) SINCE 1950 IN REPORTS OF THE CORPS OF ENGINEERS. MEASURED DISCHARGE, INTERMITTENTLY FROM 1882 TO 1904, AND 1932 TO DATE. DAILY DISCHARGE, JAN. 1933 TO DATE. ALSO IN REPORTS OF THE GEOLOGICAL SURVEY.

EXTREMES. HIGHEST, 48.7 FEET ON FEB. 10, 1937. LOWEST, MINUS 10.70 FEET ON JUL. 10 AND 11, 1988. MAXIMUM, 2,020,000 CFS WAS MEASURED ON FEB. 7, 1937 (STAGE, 48.3). MINIMUM, 78,000 CFS ON AUG. 25, 1936 (STAGE, 0.0).

DAILY EIGHT A.M. STAGE IN FEET GAGE ZERO, 183.91 FEET, N.C.V.D. OF 1929

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-3.4	16.5	31.1	18.3	14.7	30.2	18.4	11.3	8.3	1.6	9.6	3.8
2	-2.9	17.1	30.6	17.6	13.9	30.2	18.1	9.9	8.1	1.2	9.1	4.5
3	-1.9	18.1	29.9	16.8	13.1	30.4	17.6	9.0	8.2	0.6	8.1	5.5
4	0.7	19.7	28.7	15.7	12.3	30.8	17.0	9.0	7.9	0.6	6.5	6.5
5	4.4	21.0	26.6	14.8	12.3	30.7	16.3	9.4	7.5	0.0	4.7	7.0
6	8.6	22.7	23.9	14.1	12.6	30.6	15.9	9.1	7.0	-0.4	3.1	7.8
7	11.5	24.1	21.2	13.1	13.2	30.4	15.5	8.6	6.6	-0.5	2.3	9.8
8	14.4	25.2	19.5	12.1	14.0	30.1	14.9	8.4	6.2	0.6	1.9	12.2
9	15.5	26.1	19.1	11.4	16.1	29.5	14.4	8.3	6.3	1.5	1.8	13.6
10	16.3	26.9	19.1	10.9	18.2	29.0	13.9	8.5	6.3	2.2	2.0	14.3
11	16.6	27.3	16.9	10.5	19.4	28.3	13.6	8.8	5.8	2.5	1.9	14.5
12	16.5	27.5	16.2	10.1	19.7	27.6	13.5	9.0	5.6	2.8	2.0	14.2
13	15.7	27.8	15.7	10.6	19.1	26.9	13.3	8.8	5.9	3.7	2.2	13.7
14	14.6	27.9	15.2	11.4	18.2	26.0	12.9	7.8	5.5	4.4	2.7	12.4
15	13.2	28.1	15.3	12.1	17.2	25.1	13.0	7.2	4.5	5.0	3.6	10.8
16	12.2	28.9	16.1	12.6	16.8	24.3	13.1	6.6	3.6	4.9	4.6	9.2
17	11.6	29.1	16.6	13.2	17.1	23.4	13.2	5.9	3.4	5.1	5.1	7.8
18	11.2	29.3	17.2	14.3	18.1	22.1	13.4	5.3	3.4	6.0	5.5	7.7
19	10.0	29.8	19.3	14.8	20.4	20.5	14.0	5.1	3.0	7.3	5.3	8.3
20	8.8	30.2	21.4	15.3	23.4	19.3	14.6	4.8	2.8	8.4	4.9	9.4
21	7.9	30.6	22.9	15.4	25.4	18.8	14.8	4.4	2.5	9.0	4.3	14.1
22	8.6	31.0	23.8	15.2	26.9	19.3	14.9	4.3	2.3	9.0	3.3	19.0
23	11.1	31.2	24.5	14.3	28.1	19.2	14.8	4.6	2.6	8.5	2.1	21.9
24	13.4	31.3	24.8	13.6	29.1	18.9	14.6	5.6	2.8	7.9	1.7	24.7
25	15.2	31.2	24.9	13.6	29.8	18.5	14.3	6.6	2.5	7.8	1.3	26.2
26	16.3	31.1	24.7	14.0	30.2	18.4	13.7	7.5	2.1	8.0	1.2	27.4
27	16.9	31.1	24.2	14.3	30.3	18.4	13.5	8.3	1.8	8.5	1.7	28.7
28	17.3	31.1	23.2	14.9	30.3	18.7	13.6	8.9	1.8	8.8	2.8	29.9
29	17.7		21.6	15.5	30.3	18.9	13.6	9.2	1.9	9.0	3.3	30.8
30	17.6		20.1	15.4	30.2	18.7	13.3	9.2	1.8	9.1	3.5	31.3
31	17.2		19.0		30.2		12.4	9.0		9.3		32.1

THE FOLLOWING REFER ONLY TO READINGS APPEARING IN THE TABLE ABOVE.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
MEAN	11.38	26.85	21.71	13.87	20.98	24.45	14.51	7.69	4.60	4.92	3.74	15.45
MAX.	17.7	31.3	31.1	18.3	30.3	30.8	18.4	11.3	8.3	9.3	9.6	32.1
MIN.	-3.4	16.5	15.2	10.1	12.3	18.4	12.4	4.3	1.8	-0.5	1.2	3.8

HIGHEST STAGE WAS 32.43 ON DEC 31.
LOWEST STAGE WAS -3.46 ON JAN 1.

5

DAILY DISCHARGE FOR 1990

LOOSAHATCHIE RIVER AT BRUNSWICK, TENN.

COMPUTED DAILY DISCHARGE IN CUBIC FEET PER SECOND

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1					438							
2	493											
3										79		
4												
5												
6		785						115			126	
7					319							
8								123				
9							140			220		
10									112			
11												
12			452									
13		329										
14					201							
15												
16		10100		270								
17	228											345
18									116			
19												7016
20												
21		331			3173							
22												
23				1043			138					
24								121				
25										109		
26	283										142	
27								122				
28												
29					168					100		
30												
31												
MEAN												
MAX.												
MIN.												

A--NO RECORD.
YEARLY RECORD INCOMPLETE.
DISCHARGE VALUES SHOWN ARE ACTUAL DISCHARGE OBSERVATIONS.

LOOSAHATCHIE RIVER AT BRUNSWICK, TENN.

LOCATION. LAT. 35-16-52, LONG 89-45-50. MILE 25.3, HIGHWAY BRIDGE ABOUT A MILE NORTH OF BRUNSWICK. THE MOUTH OF LOOSAHATCHIE RIVER IS 740.6 MILES UPSTREAM ON THE MISSISSIPPI RIVER FROM HEAD OF PASSES.

GAGE. STAGE DETERMINED FROM MARK ON GUARDRAIL ON UPSTREAM SIDE OF BRIDGE.

GENERAL INFORMATION. DRAINAGE AREA, 506 SQUARE MILES. BANKFULL STAGE, 21 FEET. DUE TO CHANNEL IMPROVEMENTS IN 1976, USING AN AUTOMATIC RECORDER ON THIS BRIDGE BECAME IMPRACTICAL.

RECORDS AVAILABLE. STAGE, JAN. 12, 1939, TO JUN. 28, 1976. STAGES PUBLISHED FROM JUN. 28, 1976, TO DATE ARE MEAN STAGES FOR TIME OF DISCHARGE OBSERVATION. COMPUTED DAILY DISCHARGE, 1939 TO JUN. 28, 1976. DISCHARGE VALUES FROM JUN. 28, 1976 TO DATE ARE ACTUAL DISCHARGE OBSERVATIONS.

EXTREMES. HIGHEST, 28.5 FEET, FROM WATERMARK, IN JAN. 1935. LOWEST OBSERVED STAGE, 4.01 FEET ON AUG 15, 1988. MAXIMUM, 39,700 CFS OBSERVED ON JAN. 9, 1946 (STAGE, 25.8). DISCHARGE NOT DETERMINED FOR RECORD HIGH STAGE. MINIMUM, 46 CFS COMPUTED FOR JUL. 16, 1944, AND SUBSEQUENT DAYS.

DAILY EIGHT A.M. STAGE IN FEET GAGE ZERO, 227.25 FEET, N.G.V.D. OF 1929

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	A	A	A	A	5.7	A	A	A	A	A	A	A
2	5.0	A	A	A	A	A	A	A	A	A	A	A
3	A	A	A	A	A	A	A	A	A	4.3	A	A
4	A	A	A	A	A	A	A	A	A	A	A	A
5	A	A	A	A	A	A	A	A	A	A	A	A
6	A	7.1	A	A	A	A	A	4.3	A	A	4.3	A
7	A	A	A	A	4.8	A	A	A	A	A	A	A
8	A	A	A	A	A	A	A	4.3	A	A	A	A
9	A	A	A	A	A	A	4.3	A	A	4.5	A	A
10	A	A	A	A	A	A	A	A	4.3	A	A	A
11	A	A	A	A	A	A	A	A	A	A	A	A
12	A	A	5.3	A	A	A	A	A	A	A	A	A
13	A	5.5	A	A	A	A	A	A	A	A	A	A
14	A	A	A	A	4.6	A	A	A	A	A	A	A
15	A	A	A	A	A	A	A	A	A	A	A	A
16	A	19.7	A	4.4	A	A	A	A	A	A	A	A
17	4.2	A	A	A	A	A	A	A	A	A	A	4.7
18	A	A	A	A	A	A	A	A	4.3	A	A	A
19	A	A	A	A	A	A	A	A	A	A	A	18.3
20	A	A	A	A	A	A	A	A	A	A	A	A
21	A	4.8	A	A	12.4	A	A	A	A	A	A	A
22	A	A	A	A	A	A	A	A	A	A	A	A
23	A	A	A	7.1	A	A	4.3	A	A	A	A	A
24	A	A	A	A	A	A	A	4.3	A	A	A	A
25	A	A	A	A	A	A	A	A	A	4.3	A	A
26	4.4	A	A	A	A	A	A	A	A	A	4.3	A
27	A	A	A	A	A	A	A	4.3	A	A	A	A
28	A		A	A	A	A	A	A	A	A	A	A
29	A		A	A	4.5	A	A	A	A	4.3	A	A
30	A		A		A		A	A		A		A
31												

THE FOLLOWING REFER ONLY TO READINGS APPEARING IN THE TABLE ABOVE

MEAN
MAX.
MIN.

A-NO RECORD.
YEARLY RECORD INCOMPLETE.
STAGES SHOWN ARE MEAN STAGES FOR TIME OF DISCHARGE OBSERVATIONS.

7

DAILY DISCHARGE FOR 1990

WOLF RIVER AT RALEIGH, TENN.

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	2229	2297	1330	1944	4371			291				
2	2117	7201	1205	1897	5280			299				
3	1925	11368	1122	1849	4510			306		1292		1630
4	2566	12531	1015	1802	4179			313		1628		
5	1761	15195	895	1754	3930			320		1008	365	
6	1612	16095	747	1725	3731			328		932		
7	1448	9994	807		2903			319				
8	1264	6093	5026		2257			311				
9	1102	4895	2906		2090		380					
10		8584	3300						288			
11		8354	3163			997			318			335
12		8651	3044						341			429
13		5849	2552									
14		3970	2124		794						476	
15		5435	5202									
16		6079	3118	713								
17	966	3966	3006	1610								1403
18	1332	2699	3260	2120		537			302			4020
19	1167	1982	3168		1183							4673
20	1166	1479	2394		3670			305				5853
21	1106	1041	2100	3815	3492			304				12280
22		1506	1952	2732	4894	1205		302				13994
23		1541		3040	4786	962	477	301				13313
24		1531		2829	4023	817		301				10529
25		1498		2543	3229	687				383		6758
26	658	1415		2147	2609	608				371	389	4890
27	839	1397		2246	2353					358		5547
28	1320	1356		5259	2146					344		4805
29	5129			3070	1415					334		4072
30	2981		2578	3860	920							5667
31	2944		2067									5968
MEAN		5500										
MAX		16095										
MIN		1041										

MAXIMUM DISCHARGE WAS 17,538 CFS ON FEB. 6.
MINIMUM DISCHARGE WAS NOT DETERMINED.

8

WOLF RIVER AT RALEIGH, TENN.

LOCATION. LAT. 35-12-08, LONG. 89-55-24. MILE 9.4, AUSTIN PEAY HIGHWAY BRIDGE. THE MOUTH OF WOLF RIVER IS 738.6 MILES UPSTREAM ON THE MISSISSIPPI RIVER FROM HEAD OF PASSES.

GAGE. AUTOMATIC RECORDER ON BRIDGE.

GENERAL INFORMATION. DRAINAGE AREA, 770 SQUARE MILES. BANKFULL STAGE, 12 FEET. DISCHARGE IS AFFECTED BY BACKWATER DURING HIGH MISSISSIPPI RIVER STAGES. RIVER CONDITIONS HAVE CHANGED SINCE 1962 DUE TO CHANNEL ENLARGEMENT AND REALIGNMENT OPERATIONS.

RECORDS AVAILABLE. STAGE, MAY 12, 1936, TO DATE. PRIOR TO NOV. 22, 1940, GAGE WAS 700 FEET DOWNSTREAM. COMPUTED DAILY DISCHARGE, 1936 TO DATE.

EXTREMES. HIGHEST, 23.72 FEET, FROM WATERMARK, ON JAN. 20, 1935. LOWEST, MINUS 5.93 FEET ON OCT. 15, 1963. MAXIMUM, 41,400 CFS COMPUTED FOR JAN. 9, 1946 (STAGE 20.4). DISCHARGE NOT DETERMINED FOR RECORD HIGH STAGE. MINIMUM, NO FLOW FROM JAN. 30 TO FEB. 9, 1937, BECAUSE OF BACKWATER.

DAILY EIGHT A.M. STAGE IN FEET GAGE ZERO, 217.22 FEET, N.G.V.D. OF 1929

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.1	0.5	0.7	E 0.1	3.2	A	A	-3.3	A	A	A	A
2	0.1	7.3	0.3	E 0.0	2.8	A	A	E -3.3	A	A	A	A
3	-0.4	8.3	0.1	E 0.0	3.1	A	A	E -3.4	A	-3.6	A	0.3
4	0.9	9.1	-0.3	E -0.1	2.7	A	A	E -3.4	A	0.9	A	A
5	-0.4	10.8	-0.6	E -0.2	2.3	A	A	E -3.4	A	-0.8	-3.2	A
6	-0.5	12.5	-1.2	-0.3	2.1	A	A	-3.4	A	E -1.0	A	A
7	-0.8	8.6	-1.3	A	1.3	A	A	-3.4	A	A	A	A
8	-0.9	5.3	4.8	A	0.2	A	A	-3.4	A	A	A	A
9	-1.4	3.5	1.5	A	0.0	A	-3.2	A	A	A	A	A
10	A	8.3	2.3	A	A	A	A	A	-3.6	A	A	A
11	A	6.7	2.0	A	A	-1.1	A	A	-3.4	A	A	-3.0
12	A	7.3	1.7	A	A	A	A	A	-3.3	A	A	-2.0
13	A	5.5	1.2	A	A	A	A	A	A	A	A	A
14	A	3.0	0.5	A	-2.1	A	A	A	A	A	-2.9	A
15	A	3.4	5.1	A	A	A	A	A	A	A	A	A
16	A	6.2	1.7	-2.9	A	A	A	A	A	A	A	A
17	-2.7	3.3	1.6	-0.9	A	A	A	A	A	A	A	-1.5
18	-0.8	2.3	1.8	0.3	A	-2.5	A	A	-3.5	A	A	2.1
19	-1.4	1.6	1.9	A	-2.0	A	A	A	A	A	A	0.6
20	-1.2	1.2	1.0	A	3.1	A	A	-3.4	A	A	A	3.9
21	-1.4	0.8	0.5	0.2	1.1	A	A	E -3.4	A	A	A	6.9
22	A	1.4	0.2	1.0	4.1	-0.1	A	E -3.5	A	A	A	9.7
23	A	1.4	A	1.6	4.2	E -1.3	-2.9	E -3.5	A	A	A	9.5
24	A	1.4	A	1.2	3.5	E -1.7	A	-3.5	A	A	A	8.2
25	A	1.3	A	1.0	2.8	E -2.1	A	A	A	-3.2	A	5.4
26	-2.5	1.0	A	0.5	2.1	-2.5	A	A	A	E -3.2	-3.3	4.5
27	-2.0	0.9	A	0.3	1.8	A	A	A	A	E -3.3	A	4.0
28	-1.6	0.7	A	5.6	1.7	A	A	A	A	E -3.3	A	4.0
29	4.6		A	1.6	1.4	A	A	A	A	-3.4	A	3.0
30	1.1		1.6	2.4	-0.4	A	A	A	A	A	A	3.0
31	1.4		0.3		A		A	A		A		3.3

THE FOLLOWING REFER ONLY TO READINGS APPEARING IN THE TABLE ABOVE.

MEAN	4.40
MAX.	12.5
MIN.	0.5

A- NO RECORD.
E- ESTIMATED.
HIGHEST STAGE WAS 12.50 ON FEB. 6.
LOWEST STAGE WAS NOT DETERMINED.

9

07032200 NONCONNAH CREEK NEAR GERMANTOWN, TN

LOCATION.--Lat 35°02'59", long 89°49'08", Shelby County, Hydrologic Unit 08010211, on left bank at downstream side of bridge on Winchester Road, 2.6 mi south of Germantown, and at mile 17.3.

DRAINAGE AREA.--68.2 mi^2.

PERIOD OF RECORD.--Occasional low-flow measurements, water years 1959-1964, 1969; October 1969 to May 1985, October 1985 to current year.

REVISED RECORDS.--WRD TN-74-1: Drainage area, WRD TN-87-1 (P).

GAGE.--Water-stage recorder. Datum of gage is 262.92 ft above National Geodetic Vertical Datum of 1929 (levels by Soil Conservation Service).

REMARKS.--Records fair. Periodic observations of water temperature are published in this report as miscellaneous water quality data.

AVERAGE DISCHARGE.--20 years (water years 1970-84, 1986-90), 107 ft^3/s, 21.29 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 13,100 ft^3/s, July 2, 1989, gage height 24.23 ft, maximum gage height 27.11 ft, Mar. 12, 1975; no flow at times most years.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 3,700 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Oct. 16	2145	5,910	16.62	Mar. 15	Unknown	Unknown	Unknown
Feb. 3	Unknown	*Unknown	*Unknown	Apr. 21	0615	5,070	15.41
Feb. 10	Unknown	Unknown	Unknown	Apr. 28	0230	4,260	14.17
Feb. 15	2345	4,830	15.05	May 20	0845	6,750	17.79
Mar. 8	Unknown	Unknown	Unknown				

Minimum discharge, .01 ft^3/s, Sept. 28, 29, 30.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	21	.62	.64	100	78	126	52	47	2.0	.36	1.7	.43
2	8.6	4.7	.76	34	2380	169	28	1140	3.0	2.2	1.4	.34
3	3.2	3.8	.83	49	4360	141	•20	207	135	2.2	1.1	.42
4	3.0	1.3	.69	360	962	95	•9.1	179	27	.55	1.0	.29
5	1.8	1.8	.59	83	107	75	•7.3	86	10	5.4	1.0	.27
6	1.3	15	.47	39	51	63	•338	30	4.4	.96	.64	.33
7	1.1	4.1	.31	29	37	•254	•160	17	1.9	.36	.55	.40
8	1.8	394	2.1	44	29	•3660	•64	12	1.1	.49	.58	.65
9	.93	59	2.2	31	369	565	31	9.1	2.7	.41	.68	.99
10	.96	17	1.2	19	•2160	294	•16	6.1	29	.25	.74	.63
11	1.6	11	.78	13	204	186	•8.7	10	9.7	.28	.53	.61
12	1.8	3.8	.59	8.9	58	137	•5.8	24	2.8	67	.41	13
13	2.3	2.7	.40	5.8	37	122	•4.2	18	.89	13	81	49
14	2.1	1.6	.33	3.9	26	109	•3.6	10	.56	3.5	10	3.7
15	2.1	8.2	.28	3.2	1520	•2000	•3.0	6.1	77	1.3	1.9	.74
16	692	15	.23	3.0	•1260	•281	•3.0	3.7	22	.77	.68	.48
17	1310	3.9	.30	75	87	83	•318	28	5.5	.50	.28	.26
18	46	3.4	.33	249	42	45	154	8.5	1.4	.31	.73	.20
19	20	2.0	5.6	99	33	31	36	298	.70	.56	.77	3.9
20	9.4	1.7	1.6	190	25	24	99	3360	.46	.59	.75	1.1
21	5.1	2.0	.67	77	20	20	2620	602	.46	.69	.55	2.2
22	3.9	52	.28	34	•693	16	270	89	406	10	.47	8.7
23	3.2	42	.11	21	258	16	57	25	24	34	.49	.83
24	2.5	16	.03	15	134	12	34	14	7.4	14	.81	.30
25	1.5	8.1	.06	31	94	12	26	7.4	5.3	3.0	.46	.13
26	1.4	3.6	.30	16	76	16	16	4.9	1.3	.92	.45	.09
27	1.5	2.9	.45	10	65	12	252	10	.73	.54	.49	.06
28	.65	3.5	.54	329	59	20	1650	15	.57	.55	.39	.02
29	.56	1.3	8.4	1600	---	25	136	8.0	.50	.76	.40	.01
30	.76	.74	400	171	---	764	44	3.8	.42	7.3	.31	.01
31	.80	---	707	47	---	151	---	2.0	---	3.6	.51	---
TOTAL	2152.88	685.76	1138.07	3789.8	15226	9504	6467.7	6280.4	783.79	176.55	111.97	90.09
MEAN	69.4	22.9	36.7	122	544	307	216	203	26.1	5.70	3.61	3.00
MAX	1310	394	707	1600	4360	3660	2620	3360	406	67	81	49
MIN	.56	.62	.03	3.0	20	12	3.0	2.0	.42	.25	.28	.01
CFSM	1.02	.34	.54	1.79	7.97	4.50	3.16	2.97	.38	.08	.05	.04
IN.	1.17	.37	.62	2.07	8.31	5.18	3.53	3.43	.43	.10	.06	.05

CAL YR 1989 TOTAL 62128.00 MEAN 170 MAX 5900 MIN .03 CFSM 2.50 IN. 33.89
WTR YR 1990 TOTAL 46407.01 MEAN 127 MAX 4360 MIN .01 CFSM 1.86 IN. 25.31

• Estimated

Reference 29

... the zones where elevations or depths have been ...

... if flood insurance is available in this community, ... insurance agent, or call the National Flood Insurance ... (800) 638-6620

APPROXIMATE SCALE

500 0 1000 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

CITY OF
MEMPHIS, TENNESSEE
SHELBY COUNTY

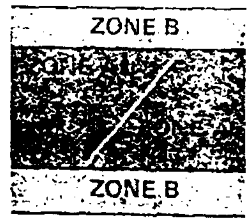
PANEL 10 OF 30

COMMUNITY-PANEL NUMBER
470177 0010 B

EFFECTIVE DATE:
DECEMBER 1, 1982

Federal Emergency Management Agency

KEY TO MAP

500-Year Flood Boundary	
100-Year Flood Boundary	
Zone Designations*	
100-Year Flood Boundary	
500-Year Flood Boundary	
Base Flood Elevation Line With Elevation In Feet**	513
Base Flood Elevation in Feet Where Uniform Within Zone**	(EL 987)
Elevation Reference Mark	RM7×
Zone D Boundary	
River Mile	•M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

*EXPLANATION OF ZONE DESIGNATIONS

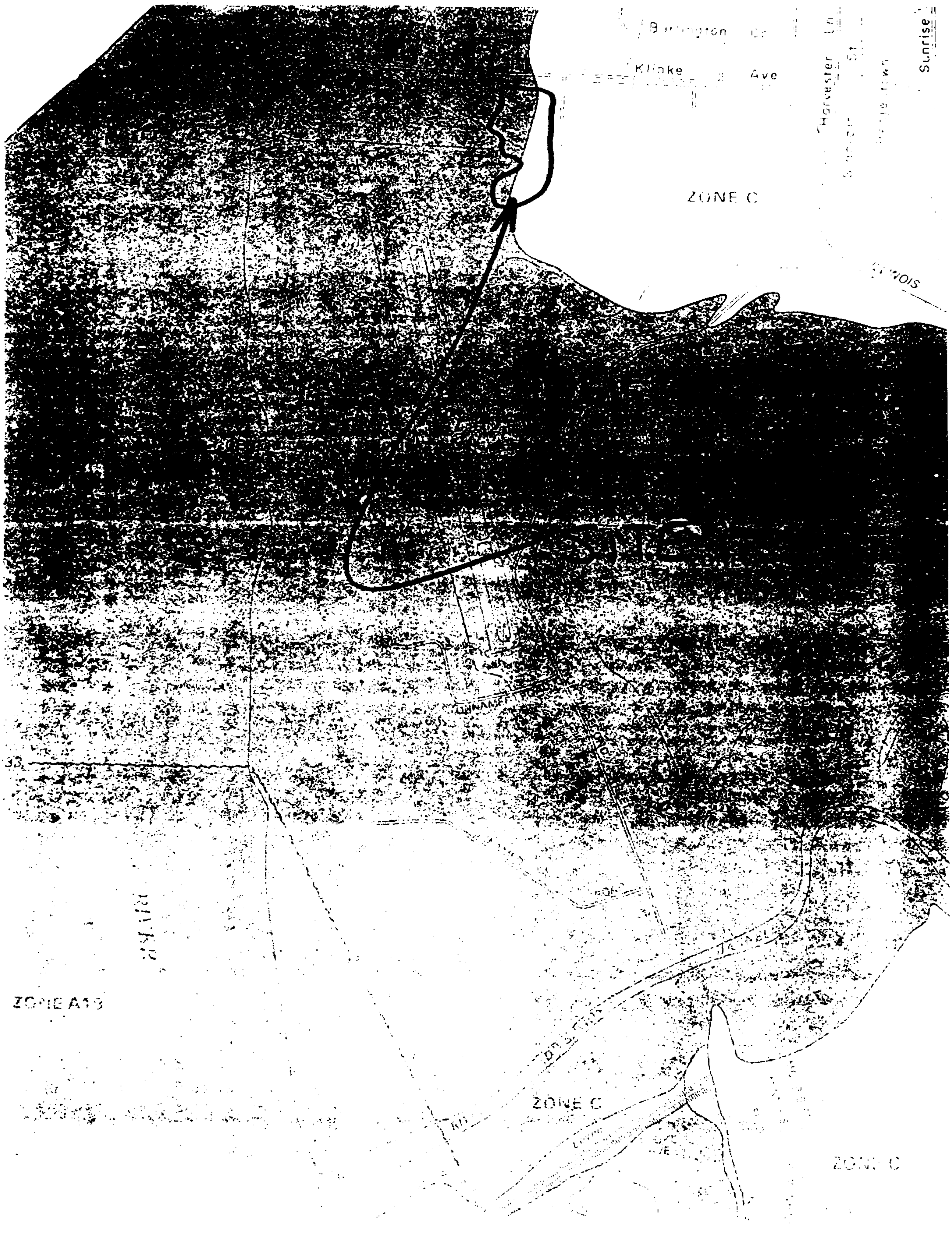
ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
A0	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NOTES TO USER

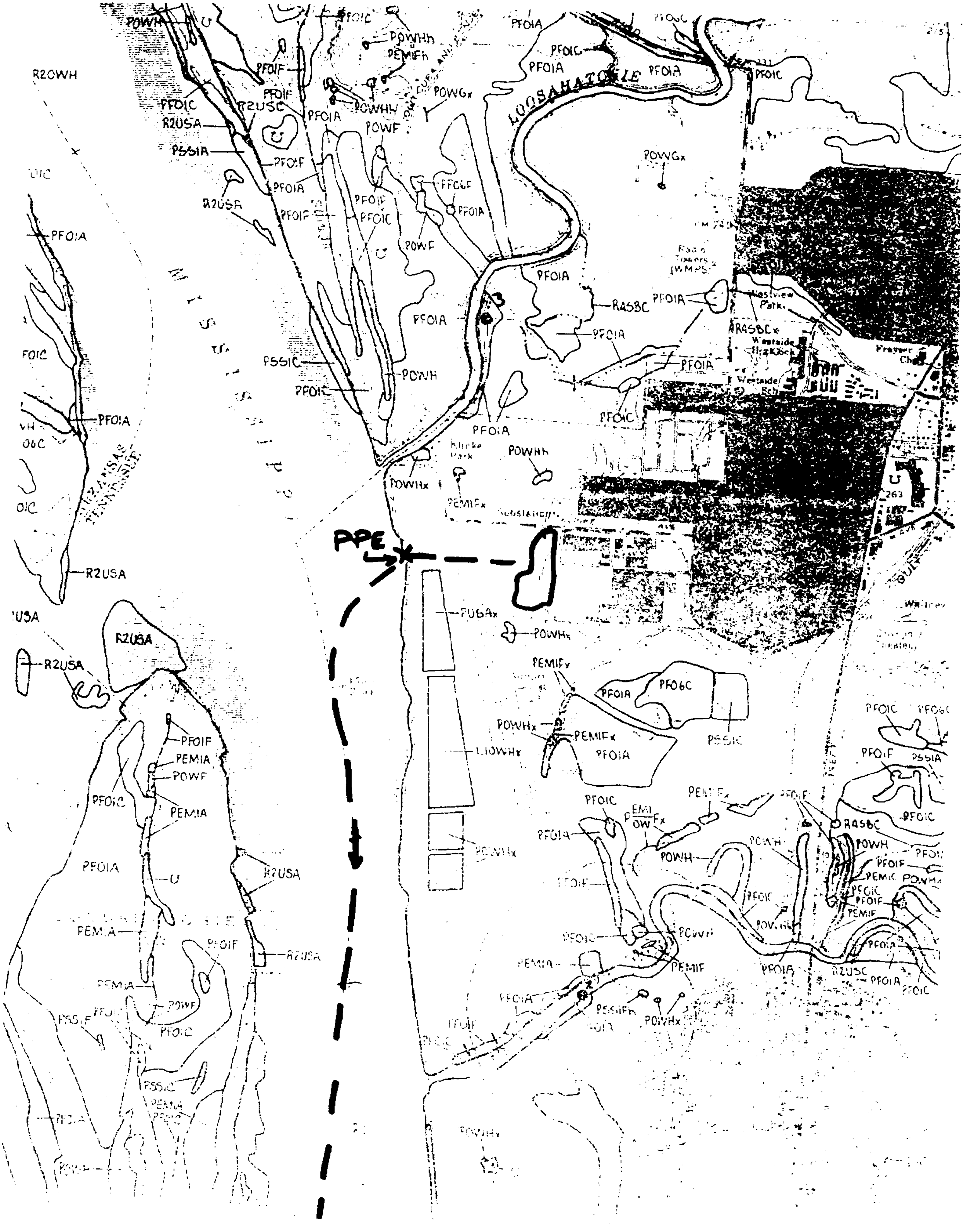
Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.

This map is for flood insurance purposes only; it does not necessarily show all areas subject to flooding in the community, or all planimetric features outside special flood hazard areas.

For adjoining map panels, see separately printed Index To Map Panels.



Klinke
Ave
Harvester
St
Sunrise
ZONE C
SITE
33
RIVER
ZONE A13
ZONE C



PPE
LOOSAHATCHIE
R2OWH
R2USA
R2USC
PSS1A
PFO1A
PFO1C
PFO1F
PEM1A
POWF
POWH
POWHx
POWGx
PEMIFx
PFO6C
PSS1C
R4SBC
Klinke Park
Substation
Westview Park
Westside High Sch
Westside Sch
Prayer Ch
Radio Towers (WMPS)
ARKANSAS
TENNESSEE

Reference 30

B&V WASTE SCIENCE AND TECHNOLOGY CORP.

TELEPHONE MEMORANDUM

Site Assessment
Old Osmose Chemical Facility

BVWST Project 52012.022
October 18, 1991
2:35 p.m.

Surface Water Intakes on the Mississippi River
Groundwater Drinking Water Population

To: Jerry Collins
Company: Department of Memphis Public Works
Phone No.: (901) 576-6720

Recorded by: Laura Morrison LM 10-18-91

Surface Water Intakes on the Mississippi River
There are no surface water intakes on the Mississippi River. rivers, streams and lakes flowing into the Mississippi river in the Memphis area have no surface water intakes.

B&V WASTE SCIENCE AND TECHNOLOGY CORP.

TELEPHONE MEMORANDUM

US EPA Site Assessment — BVWST Project 52012.xxx
Memphis, Tennessee SIPs — BVWST File
Fishing and Recreation on Memphis area water bodies — July 1, 1992
9:15 a.m.

To:	John Rayfield
Company:	TN Wildlife Resource Agency, Shelby County office
Phone No.:	(901) 753-1351
Recorded by:	Paul Delphos PD 6-1-92

The following water bodies are the only Memphis area rivers which are monitored and/or evaluated by the TN Wildlife Resource Agency. All other creeks are not considered large enough to be monitored. These water bodies include:

Mississippi River
Loosahatchie River
Nonconnah Creek
Wolf River
Lake McKellar

There is a commercial fishing ban for all these water bodies, and it is recommended for recreational fishing that "no consumption of fish" occurs with fish caught from these rivers. This statement is made in the area's fishing guide and Mr. Rayfield only knows of signs posted on Lake McKellar as it is the most utilized water body in the area. He verified that recreational fishing occurs on the above mentioned rivers and caught fish are carried away, therefore, Mr. Rayfield assumes the fish are eaten. He also stated that boating, water skiing, and swimming occur on the above mentioned water bodies, with Lake McKellar being used the most and the Mississippi River being used the least.r

B&V WASTE SCIENCE AND TECHNOLOGY CORP.

TELEPHONE MEMORANDUM

BVWST Project 52012.003
December 23, 1991
12:50 p.m.

Recreational Fishing

To: John Condor, Wildlife Manager
Company: Wildlife Resources Agency
Phone No.: (901) 423-5725

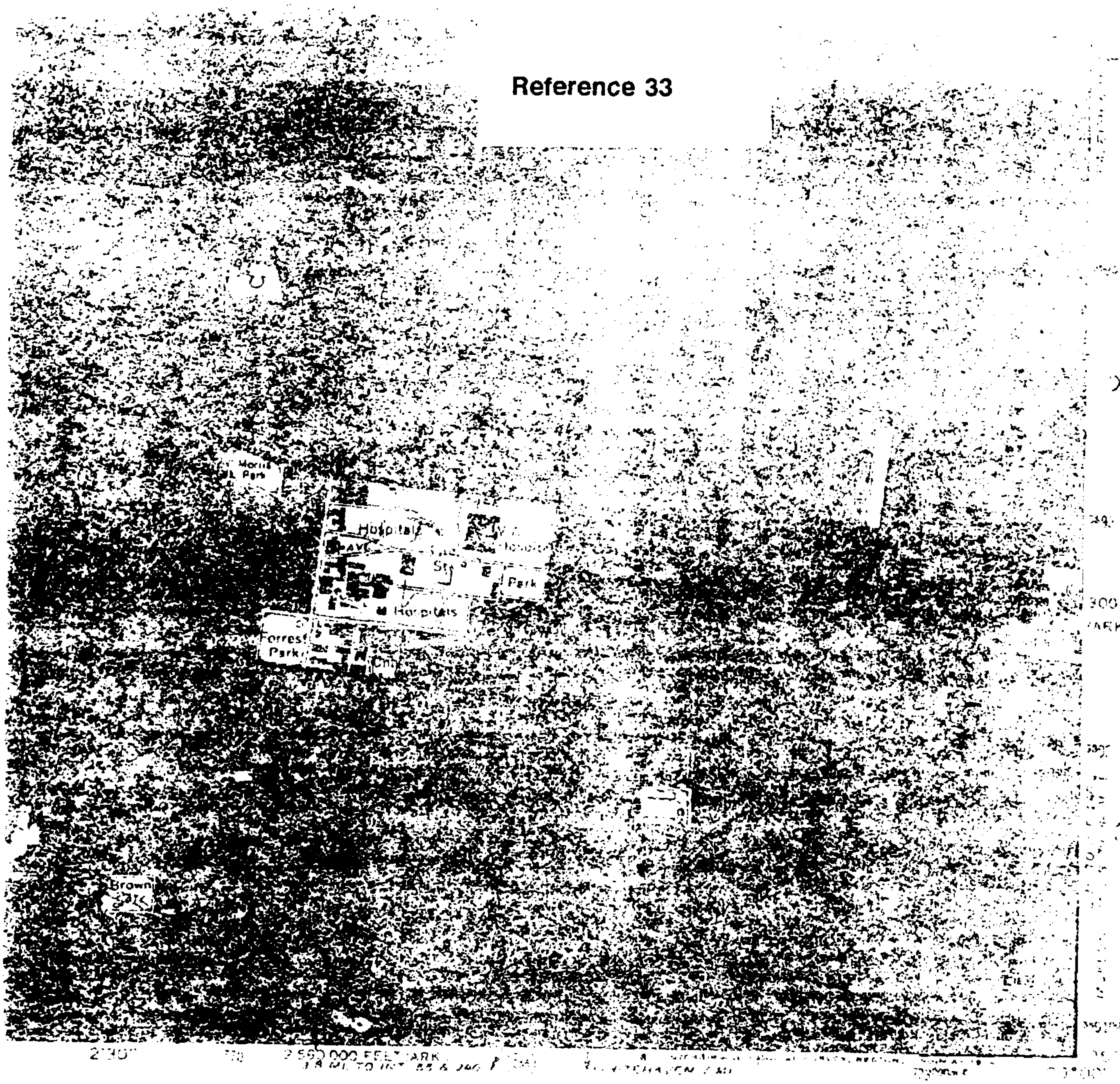
Recorded by: Laura Morrisson LM 12-23-91

There has been a commercial fishing ban on the Mississippi River and connecting streams from Tipton County to the Mississippi state line since 1985. Periodic fish sampling has shown chlordane in fish in the Mississippi River. There are warnings posted about eating the fish from the Mississippi River. Recreational fishing occurs despite these warnings.

Arkansas has never participated in the fishing bans on the Mississippi River, even though they are aware of the potential hazards.

/ms

Reference 33



2'

1'

NORTHWEST MEMPHIS, TENN - ARK

NOTES TO THE USER

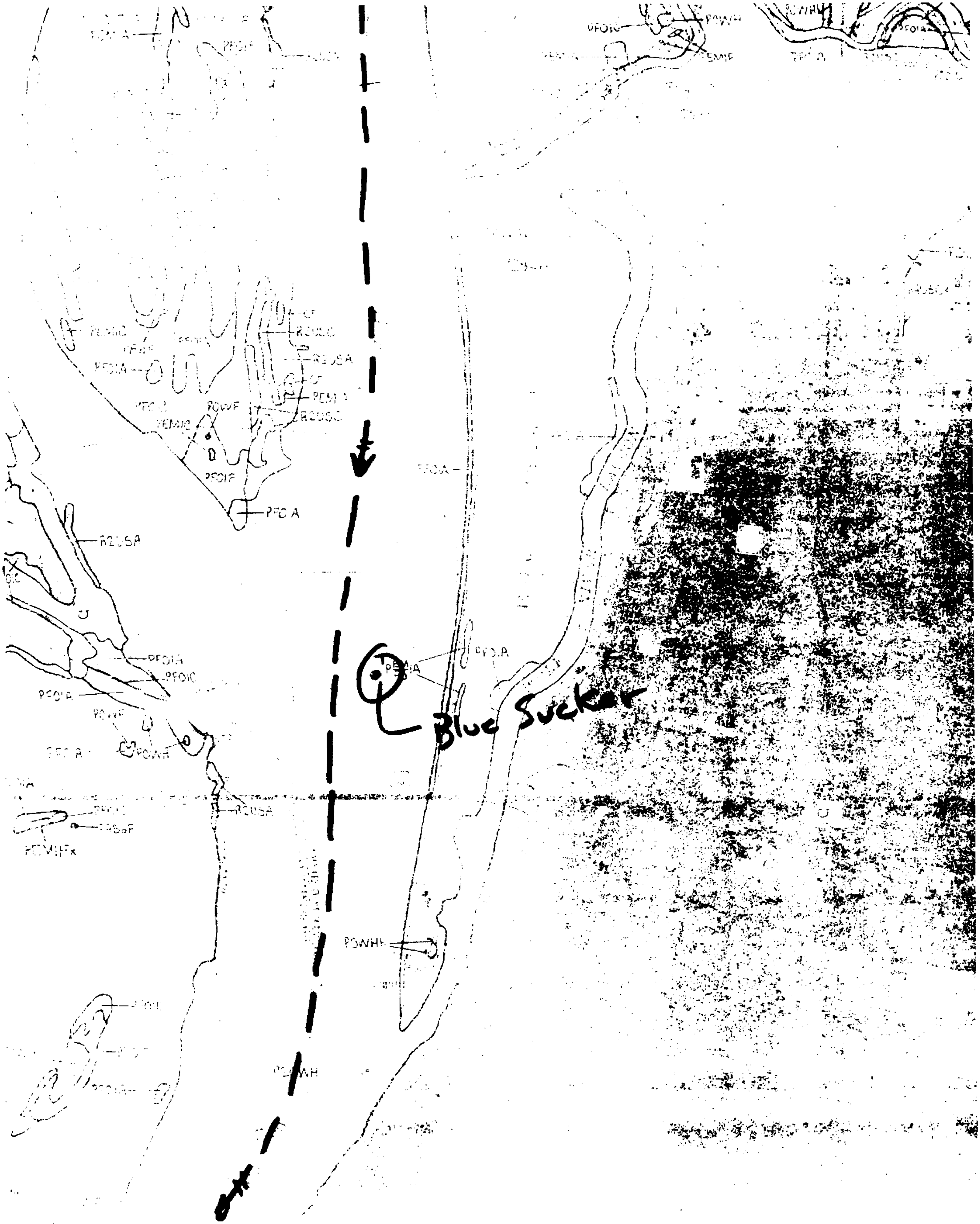
- Wetlands which have been field examined are indicated on the map by an asterisk (*).
- Additions or corrections to the wetlands information displayed on this map are solicited. Please forward such information to the address indicated.
- Subsystems, Classes, Subclasses, and Water Regimes in *italics* were developed specifically for NATIONAL WETLANDS INVENTORY mapping.
- Some areas designated as R4SB, R4SBW, OR R4SBJ (INTERMITTENT STREAMS) may not meet the definition of wetland.
- This map uses the class Unconsolidated Shore (US). On earlier NWI maps that class was designated Beach Bar (BB), or Flat (FL). Subclasses remain the same in both versions.

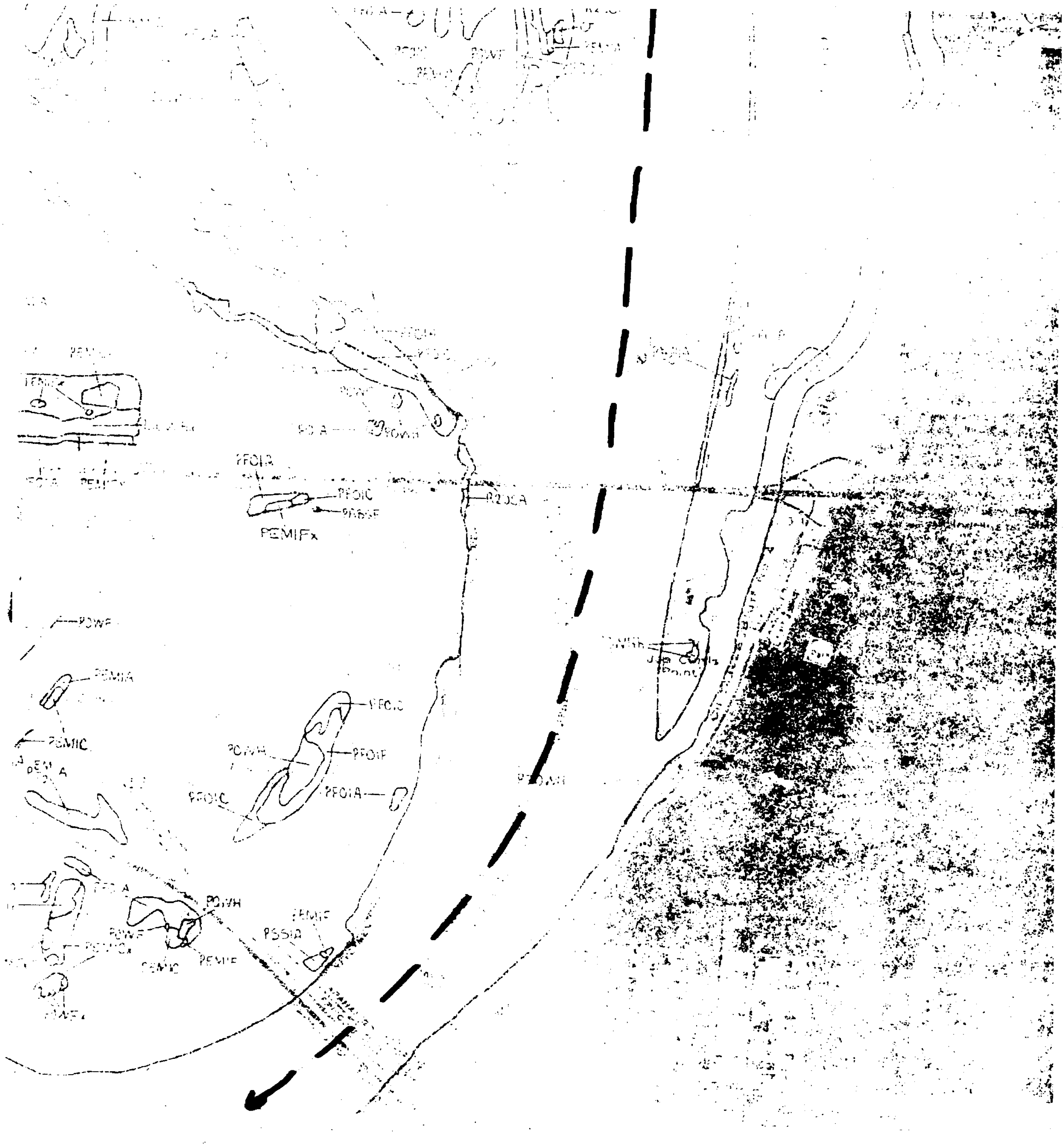
DEPARTMENT OF THE INTERIOR MARCH 3, 1849

U.S. DEPARTMENT OF THE INTERIOR

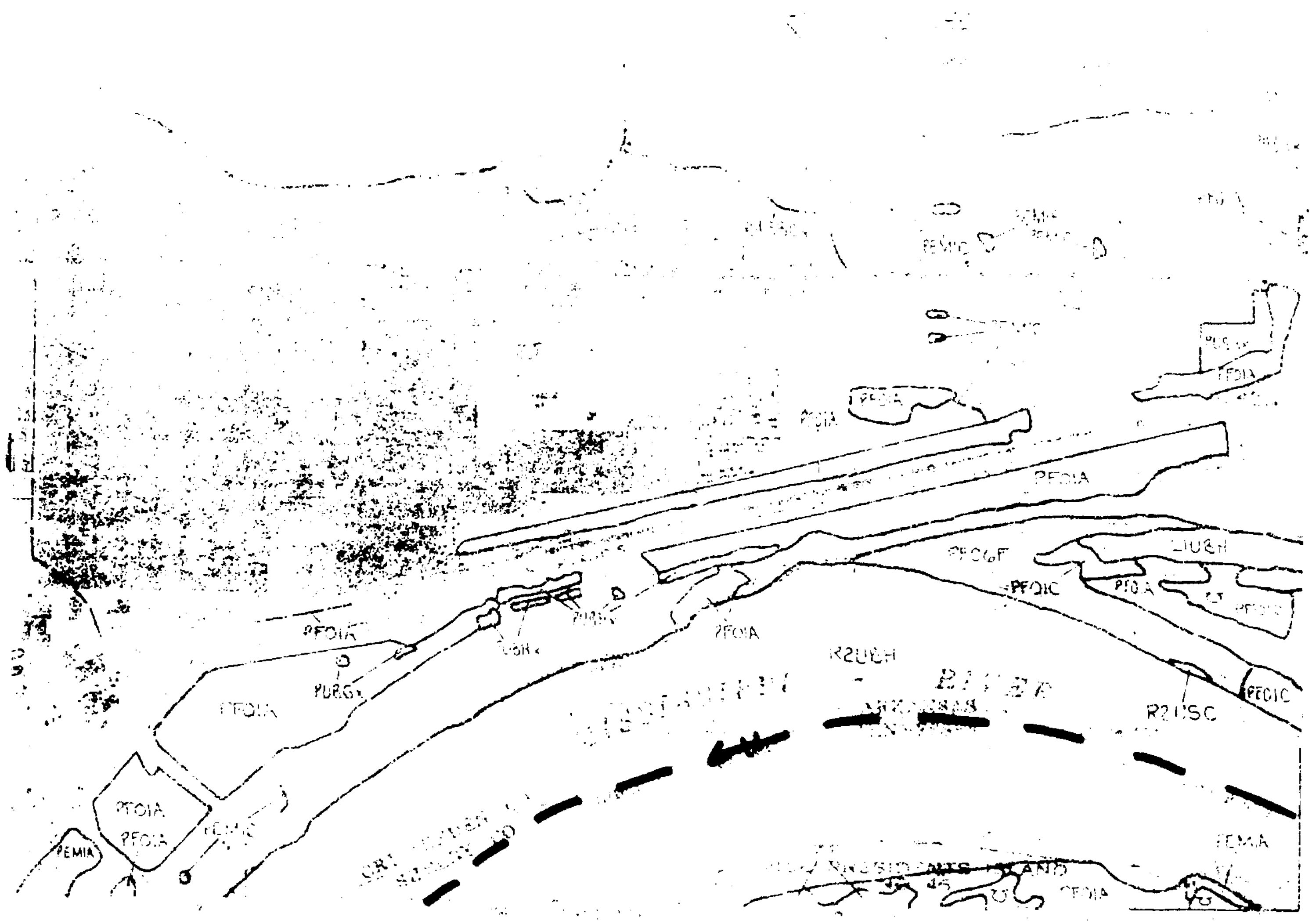
FISH AND WILDLIFE SERVICE

Prepared by *National Wetlands Inventory*


Blue Sucker
PFO1A
R2USA
PFO1C
POWF
POWH
PEM1C
PFO1F
R2USC
POWHh



SPECIAL NOTE



WEST MEMPHIS, ARK.-TENN.

NOTES TO THE USER

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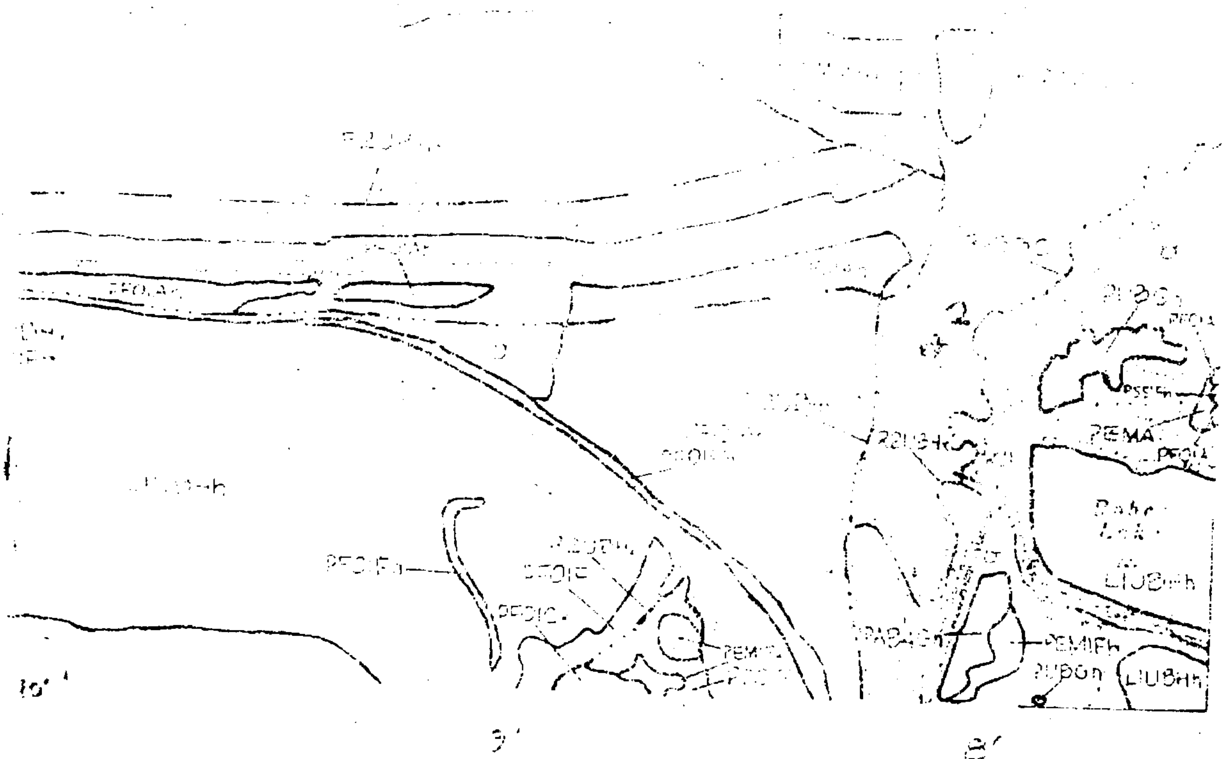
U.S. DEPARTMENT OF THE INTERIOR
MARCH 3, 1849



NOTES TO THE USER

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U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

Wetlands Inventory

AERIAL PHOTOGRAPHY

TE	3 ... 86	DATE	
LE	58 000	SCALE	
PE	CIR	TYPE	

ETLANDS INVENTORY


END SURFACE WATER PATHWAY
PEMA
PSS1A
PEM1A

Reference 34

EXPLANATION OF FEDERAL STATUS DESIGNATIONS

FEDERAL STATUS, DETERMINED BY THE U. S. FISH AND WILDLIFE SERVICE[1]

E/SA	-	Endangered by similarity of appearance
LE	-	Taxa formally listed as endangered
LT	-	Taxa formally listed as threatened
PE	-	Taxa proposed to be formally listed as endangered
PT	-	Taxa proposed to be formally listed as threatened
S	-	Synonyms
LTXN	-	Listed threatened, non-essential experimental population

C1 - Taxa for which the Service has on file substantial information on biological vulnerability and threats to support the appropriateness to list them as endangered or threatened species. Included are those taxa whose status in recent past is known, but may have already become extinct. Such possibly extinct taxa are indicated by an asterisk (*). Double asterisk (**) indicate taxa believed to be extinct in the wild, but known to be extant in cultivation.

C2 - Taxa for which information now in possession of the Service indicated that proposing to list them as endangered or threatened is appropriate, but for which substantial data on biological vulnerability and threat(s) are not currently known or on file to support a proposed rule.

C3- Taxa that are no longer being considered for listing as threatened or endangered species. The following subcategories are used to further indicate the reason(s) for removal from consideration.

3A - Taxa for which the Service has persuasive evidence of extinction of being destroyed. If rediscovered, such taxa might acquire high priority for listing.

3B - Names that on the basis of current taxonomic understanding do not represent taxa meeting the Acts definition of "species." Such proposed taxa could be reevaluated in the future on the basis of subsequent research.

3C - Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat.

NOTE: The taxa listed in Categories 1 and 2 may be considered candidates for addition to the list of Endangered and Threatened plants, and, as such, consideration should be given them in environmental planning.

1. Federal Register, 50 (188), September 18, 1985, pp. 37958-37959, and September 27, 1985, pp. 39526-39527.

DEFINITIONS OF STATE STATUS FOR THE OFFICIAL LIST OF TENNESSEE'S RARE PLANTS[1]

E - ENDANGERED, Species now in danger of becoming extinct in Tennessee because of:

(a) their rarity throughout their range, or

(b) their rarity in Tennessee as a result of sensitive habitat destruction or restricted area of distribution.

E* - TAXA considered to be endangered in Tennessee due to evidence of large numbers being taken from the wild and lack of commercial success with propagation or transplantation.

T - THREATENED, Species likely to become endangered in the immediately foreseeable future as a result of rapid habitat destruction or commercial exploitation.

S - SPECIAL CONCERN, Species requiring special concern because of:

(a) their rarity in Tennessee because the State represents the limit or near-limit of their geographic range, or

(b) their status is undetermined because of insufficient information.

P - POSSIBLY EXTIRPATED, Species that have not been seen in Tennessee within the past 20 years.

1. Adapted from the Committee for Tennessee Rare Plants. 1978. The rare and vascular plants of Tennessee. J. Tenn. Acad. Sci. 53(4):128-133.

STATE STATUS OF TENNESSEE'S RARE WILDLIFE
(Designated by Tennessee Wildlife Resource Agency)

STATUS DESIGNATIONS

P - Possibly extirpated
E - Endangered
T - Threatened
S - Special Concern
I - Inactive
D - Deemed in Need of Management
* - Species Proposed for Federal Protection
ESD - Designated by the Ecological Services Division

Reference 35

Graphical Exposure Modelling System (GEMS)
Data Download
September 2, 1993
9:30 a.m.

Data Compiled by Dane G. Pehrman
B&V Waste Science and Technology Corp.
1990 Census Data
International Harvester Landfill Site Inspection Prioritization

Population within 4 miles of the International Harvester Landfill Site
Latitude:35°12'24.08"
Longitude:90°03'03.64"

Distance	Population	Interval Pop.
0 (km)	0	
		0
0.4 (km)	0	
		0
0.8 (km)	0	
		2,599
1.6 (km)	2,599	
		6,128
3.2 (km)	8,727	
		20,234
4.8 (km)	28,961	
		31,602
6.4 (km)	60,563	

POOR LEGIBILITY

PORTIONS OF THIS DOCUMENT MAY BE UNREADABLE, DUE TO THE QUALITY OF THE ORIGINAL

Potential Hazardous Waste Site

PRELIMINARY ASSESSMENT

INTERNATIONAL HARVESTER

MEMPHIS, SHELBY COUNTY, TENNESSEE

TND 007 02 4516

PRELIMINARY ASSESSMENT
INTERNATIONAL HARVESTER
TND 007 02 4516

I. HISTORY OF SITE

The International Harvester Company is located in Memphis, Tennessee, Shelby County approximately one-half mile from the Mississippi. The land in the area is mainly flat with some gently sloped hills.

This company manufactures farm equipment and the manufacturing process includes: casting shearing, machine, welding, assembly, washing, plating and painting.

International Harvester has been in operation since 1947. The company has been operating a disposal site on company property, adjacent to its manufacturing operation from the early 1940's to November 1983. At present the disposal site has been inactive four years, yet closure has not been documented or made available to state superfund file.

II. NATURE OF HAZARDOUS MATERIALS

According to the feasibility study of industrial waste fill site, a hazardous waste site investigation conducted by E.P.A. on October 20-21, 1980, at the International Harvester disposal site noted detectable quantities of lead, chromium and P.C.B's. chromium levels in water samples taken at the site noted the drinking water standards for chromium limits its concentration to 0.05 mg/l. lead levels in water samples taken showed the concentration to be less than 0.04 mg. which is less than the DWS limits of 0.05 mg/l.

Soil and sediments samples taken at the site also indicate detectable levels of lead, chromium, and PCB's. Samples taken at five locations showed a chromium concentration range 30 to 278 mg/kg and a lead concentration ranging from 57 to 468 mg/kg. PCB's were detected in all soil and sediment samples with concentrations ranging from 180 ug/kg to 18,000 ug/kg quantity of hazardous waste is unknown at this time. International Harvester's landfill is located in a flood plain.

III. DESCRIPTION OF HAZARDOUS CONDITION, INCIDENTS, PERMIT VIOLATION

There is unstable containment due to the fact that the Landfill is located in a floodplain, and therefore requires protection from possible floodwaters.

IV. ROUTE'S FOR CONTAMINATION

Drainage ditches on site empty toward the Mississippi River.

The landfill lies in the flood plains of the Mississippi River and is not protected from possible flood waters.

The site drains also into fields that grow soybeans and wheat.

V. POSSIBLE AFFECTED POPULATION AND RESOURCES

There is a potential for surface water contamination due to possible floodwaters, possible groundwater contamination due to the aquifer of concern and possible food contaminations.

Approximately 2000,00 populus could be affected.

VI. RECOMMENDATION AND JUSTIFICATIONS

This site has become inactive as of November 1983. It is considered to be a RCRA facility. It should be noted for the DSWM that there exist the potential for existing irregularities in waste distribution and a determination of the potential harm of the hazardous waste alleged to be present should be looked into.

RCRA ASSESSMENT

In State Superfund estimation this site (International Harvester) is a RCRA facility.

Since the landfill was in full operation, storing hazardous waste over the alloted time and was considered an active site up until 1983.

The State Superfund Program has conducted remedial action, but at this time International Harvester is considered a RCRA facility and no further action will be taken on behalf of Site Investigation, Division of Superfund.

TH/lag SF #5

REFERENCES

1. Tennessee Department of Health and Environment State Superfund file # 79-525(1).

2. Tennessee Department of Health and Environment Solid Waste Management file # 79-525.

3. Feasibility study of industrial waste fill site. Prepared by: Environmental Management Planning & Engineering March 1982.

4. Tennessee Department of Health and Environment Division of Solid Waste Management Commissioners Orders.

5. Topographic Map of Northwest Memphis Quadrangle.

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION
01 STATE: TN | 02 SITE NUMBER: D 007-02-4516

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site): International Harvester Company EPIC #73	02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER: 3003 Harvester Lane
03 CITY: Memphis	04 STATE: TN; 05 ZIP CODE: 38127; 06 COUNTY: Shelby; 07 COUNTY CODE: 157; 08 CONG DIST: 8
09 COORDINATES LATITUDE: 35 12 23. LONGITUDE: 90 03 05.	

10 DIRECTIONS TO SITE (Starting from nearest public road)
I-240 west until road forks, go north on Thomas, to Marsch, turn west on Marsch to Sunrise North to Frayer then west to Harvester.

III. RESPONSIBLE PARTIES

01 OWNER (If known): International Harvester Corporation	02 STREET (Business, mailing, residential): 3003 Harvester Lane
03 CITY: Memphis	04 STATE: TN; 05 ZIP CODE: 38127; 06 TELEPHONE NUMBER: (901) 357-5311
07 OPERATOR (If known and different from owner): International Harvester Corporation	08 STREET (Business, mailing, residential): 3003 Harvester Lane
09 CITY: Memphis	10 STATE: TN; 11 ZIP CODE: 38127; 12 TELEPHONE NUMBER: (901) 357-5311

13 TYPE OF OWNERSHIP (Check one)
☒ A. PRIVATE ☐ B. FEDERAL: ______ (Agency name) ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL
☐ F. OTHER: ______ (Specify) ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)
☐ A. RCRA 3001 DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: __/__/__ (MONTH DAY YEAR) ☒ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION
☒ YES DATE 10 20 80 (MONTH DAY YEAR)
☐ NO
BY (Check all that apply)
☒ A. EPA ☐ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR
☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: ______ (Specify)
CONTRACTOR NAME(S): ______

02 SITE STATUS (Check one)
☐ A. ACTIVE ☐ B. INACTIVE ☒ C. UNKNOWN

03 YEARS OF OPERATION
1947 (BEGINNING YEAR) 1983 (ENDING YEAR) ☐ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED
Alleged chromium and lead, PCB's and some extractable/purgeable organic compounds.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION
Drainage ditches on site that empty toward the Mississippi River. The landfill lies in the flood plains of the Mississippi River and is not protected from possible flood water.

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)
☐ A. HIGH (Inspection required promptly) ☒ B. MEDIUM (Inspection required) ☐ C. LOW (Inspect on time available basis) ☐ D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT: Z.S. Migut	02 OF (Agency Organization): International Harvester			03 TELEPHONE NUMBER: (901)357-5311
04 PERSON RESPONSIBLE FOR ASSESSMENT: Robin Tanya Humphries	05 AGENCY: TDH&E	06 ORGANIZATION: Superfund	07 TELEPHONE NUMBER: (615) 741-3424	08 DATE: 05 13 87 (MONTH DAY YEAR)

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
TN	D 007-02-4516

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check as that apply)

- [x] A SOLID
- [ ] B POWDER, FINES
- [x] C SLUDGE
- [ ] D OTHER ______ (Specify)
- [ ] E SLURRY
- [ ] F LIQUID
- [ ] G GAS

02 WASTE QUANTITY AT SITE (Measures of waste quantities must be independent)

TONS ______

CUBIC YARDS ______

NO OF DRUMS ______

03 WASTE CHARACTERISTICS (Check as that apply)

- [x] A TOXIC
- [ ] B CORROSIVE
- [ ] C RADIOACTIVE
- [ ] D PERSISTENT
- [ ] E SOLUBLE
- [ ] F INFECTIOUS
- [ ] G FLAMMABLE
- [ ] H IGNITABLE
- [ ] I HIGHLY VOLATILE
- [ ] J EXPLOSIVE
- [ ] K REACTIVE
- [ ] L INCOMPATIBLE
- [ ] M NOT APPLICABLE

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE	6000.00	KG	
OLW	OILY WASTE	unknown		
SOL	SOLVENTS			
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
D007	Chromium	7446.47.3	Unknown		
D008	Lead	1335257			

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

TDHE, Superfund File

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION
01 STATE: TN | 02 SITE NUMBER: D 007-02-4516

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 [X] A. GROUNDWATER CONTAMINATION | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [X] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00 | 04 NARRATIVE DESCRIPTION

Due to the variations of the Memphis sands, this aquifer has a possibility for ground water contamination.

01 [X] B. SURFACE WATER CONTAMINATION | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [X] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00 | 04 NARRATIVE DESCRIPTION

The landfill lies in the flood plains of the Mississippi River and is not protected from possible flood waters.

01 [ ] C. CONTAMINATION OF AIR | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [ ] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: | 04 NARRATIVE DESCRIPTION

01 [ ] D. FIRE/EXPLOSIVE CONDITIONS | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [ ] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: | 04 NARRATIVE DESCRIPTION

01 [X] E. DIRECT CONTACT | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [X] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00 | 04 NARRATIVE DESCRIPTION

Possible drinking water contamination.

01 [X] F. CONTAMINATION OF SOIL | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [X] ALLEGED
03 AREA POTENTIALLY AFFECTED: 10 acres (Acres) | 04 NARRATIVE DESCRIPTION

Possible contamination of soil.

01 [X] G. DRINKING WATER CONTAMINATION | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [X] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00 | 04 NARRATIVE DESCRIPTION

Alleged chromium and lead were below or slightly above drinking water limits.

01 [ ] H. WORKER EXPOSURE/INJURY | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [ ] ALLEGED
03 WORKERS POTENTIALLY AFFECTED: | 04 NARRATIVE DESCRIPTION

01 [ ] I. POPULATION EXPOSURE/INJURY | 02 [ ] OBSERVED (DATE:) | [ ] POTENTIAL | [ ] ALLEGED
03 POPULATION POTENTIALLY AFFECTED: | 04 NARRATIVE DESCRIPTION

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
TN	D 007-02-4516

II. HAZARDOUS CONDITIONS AND INCIDENTS (Continued)

01 ☐ J. DAMAGE TO FLORA — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ K. DAMAGE TO FAUNA — 02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION (include name(s) of species)

01 ☒ L. CONTAMINATION OF FOOD CHAIN — 02 ☐ OBSERVED (DATE ______) ☐ POTENTIAL ☒ ALLEGED
04 NARRATIVE DESCRIPTION

Site drains into fields tht grow soybeans and wheat.

01 ☒ M. UNSTABLE CONTAINMENT OF WASTES (Spills/runoff/standing liquids/leaking drums) — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☒ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: 2000.00
04 NARRATIVE DESCRIPTION

Landfill is out of compliance with the flood plain criteria.

01 ☐ N. DAMAGE TO OFFSITE PROPERTY — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ P. ILLEGAL/UNAUTHORIZED DUMPING — 02 ☐ OBSERVED (DATE: ______) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

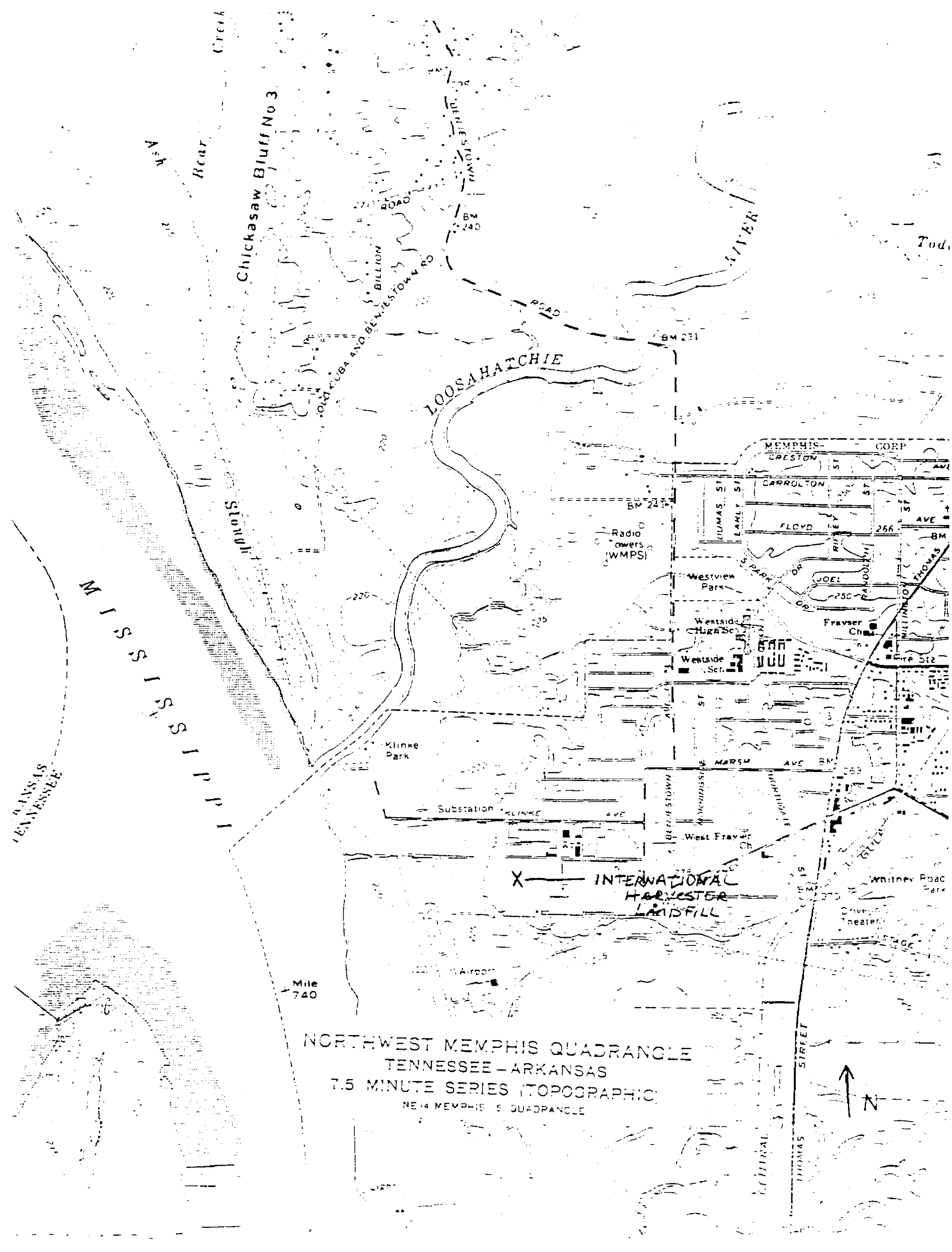
Chromium, lead, PCB's, other organic waste.

III. TOTAL POPULATION POTENTIALLY AFFECTED: ______

IV. COMMENTS

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

TDHE Superfund File
Feasibility study of industrial waste fill site prepared for International Harvester Co. by Environmental Management Planning and Engineering.



NORTHWEST MEMPHIS QUADRANGLE
TENNESSEE-ARKANSAS
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 MEMPHIS 15' QUADRANGLE
INTERNATIONAL HARVESTER LANDFILL
N
MISSISSIPPI
LOOSAHATCHIE
RIVER
Chickasaw Bluff No 3
Slough
Mile 740
Klinke Park
Substation
Radio Towers (WMPS)
Westview Park
Westside High Sch
Westside Sch
Frayser Ch
West Frayser Ch
Whitney Road Park
Drive-in Theater
Airport
MEMPHIS CORP
CRESTON
CARROLTON
FLOYD
JOEL
MARSH AVE
KLINKE AVE
THOMAS STREET
BM 231
BM 240
BM 241
ROAD
OLD CUBA AND BENJESTOWN RD
BILLION
TENNESSEE
ARKANSAS

Site No. TND

Reference No. 79-525-(1)

INTERNATIONAL HARVESTER
3003 HARVESTER AVENUE
MEMPHIS, TENNESSEE

I. Site Identification

A. Name - International Harvester
B. County - Shelby
C. Nearest Urban Area - Memphis
D. Water Supplies Potentially Affected

1. Public - Not affected
2. Private - Not affected
3. Other

a) Drainage ditches on site empty towards the Mississippi River

b) The landfill lies in the floodplains of the Mississippi River and is not protected from possible floodwaters.

c) The site also drains into fields that grow soybeans and wheat.

E. Acreage - 10 acres

II. Site History

A. Owner - International Harvester Corp.
B. Operator - International Harvester Corp., G. W. Beadles, Manager
C. Hazardous Waste Data

1. Source - International Harvester
2. Volume - approximately 1000-2000 tons
3. Types of Wastes - Wood, paper, foundry sand, glass, metal scraps, cardboard, trash, paint and paint sludge, washing machine sludge, oils, greases, coolants, wastewater treatment sludge, spent transformer oil, varnish, sealing compound, caustics and acids, electroplating treatment sludge and miscellaneous industrial solid waste

D. Period of Operation - 1947 to present

E. Current Status - Feasibility study for closure submitted to SWM Superfund.

III. Investigations

A. Sampling Data

On October 20-21, 1980, EPA conducted a hazardous waste site investigation. During this investigation five sediment or soil samples and two water samples were collected. Chromium and lead were below or slighly above drinking water limits in water, but were very high in sediment/soil; high levels of PCBs were found in all soil samples, and

moderate to low amounts of some extractable/purgeable organic compounds were also found in soil/sediment samples.

Although chromium and lead contamination may enter the Mississippi River, the flow of this river, 470,000 cu. ft/sec., is enough to dilute it. The metal, PCB and organic-contaminated soil may, however, be washed into adjacent fields, which grow food crops, and may also migrate in the event of flooding.

B. Other Investigating Work - None

C. Costs Incurred

Entity	Activity	Cost
EPA	Site Investigation	$15,000

IV. Enforcement Action

1. TN

September 1, 1981 - (SWM & EPA) International Harvester informed that their landfill was out of compliance with the floodplain criteria and was on the EPA open dump inventory.

September 17, 1981 - March 17, 1982 - Extension granted for submittal of a feasibility study for correcting the floodplain problem. Feasibility study submitted March 17, 1982. International Harvester accepted recommendation to close the landfills but subsequently developed financial problems. SWM allowed sufficient time for them to recover financially before requiring closure.

May 6, 1983 (SWM) - Hazardous Waste inspection found no violations for hazardous waste generators.

November, 1983 SWM Superfund staff reviewed closure plan and developed recommendations.

2. EPA

October 20, 1980 - Conducted a hazardous waste site inspection.

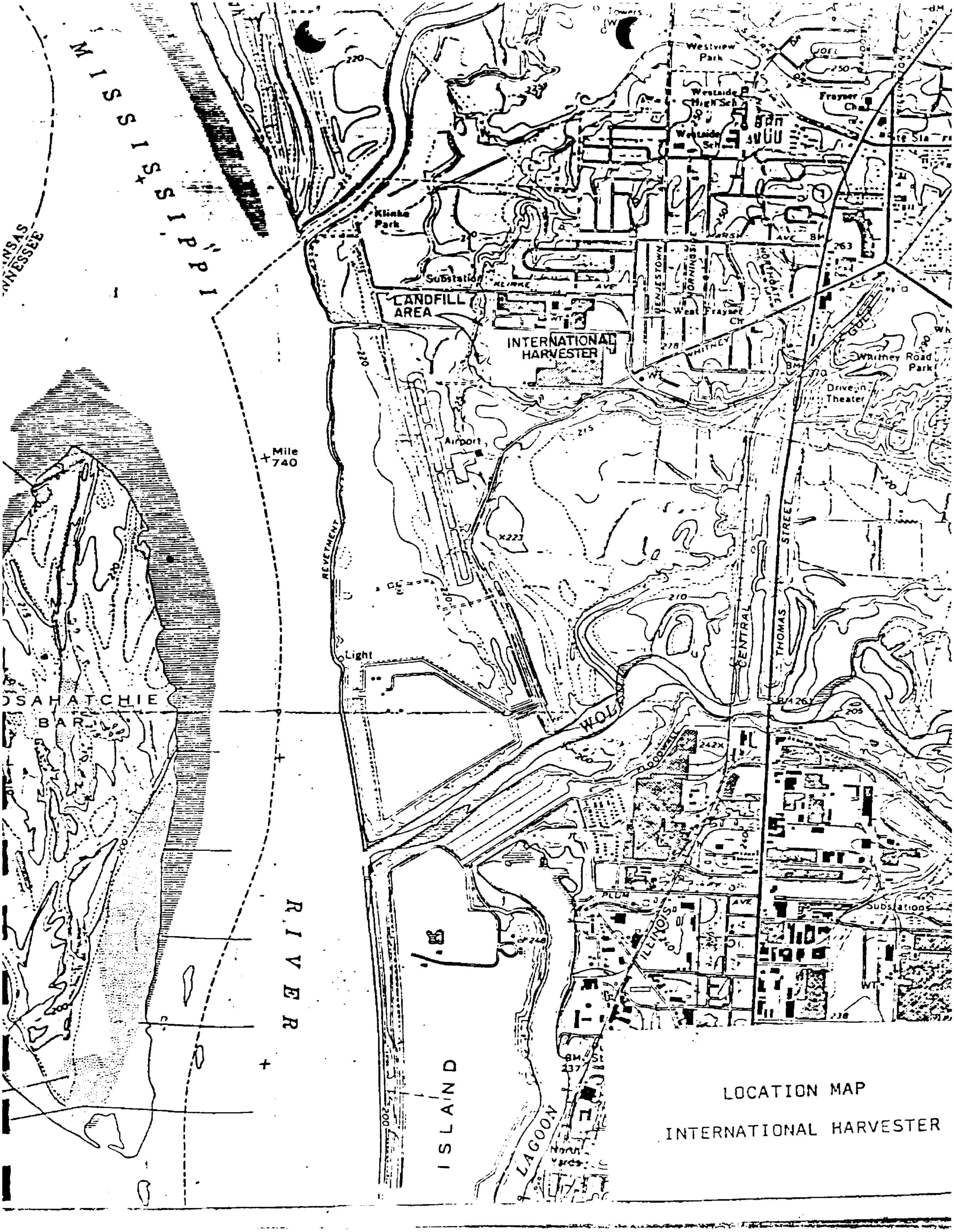
October 23, 1981 - International Harvester informed of potential violations of RCRA.

3. Local - None

V. Remedial Action

Entity	Activity	Cost

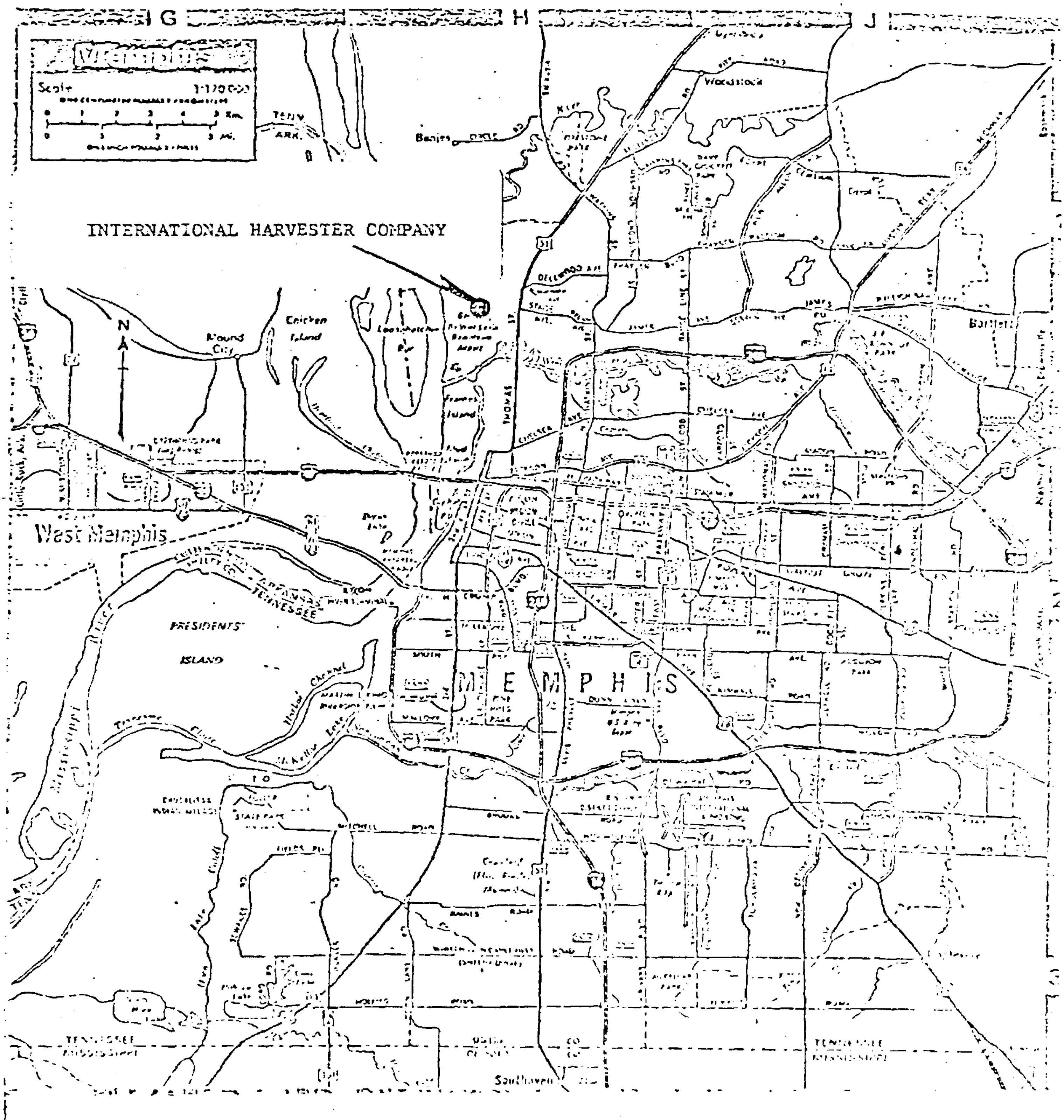
None to date



LOCATION MAP

INTERNATIONAL HARVESTER

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE



Site No. TND ____________

Reference No. # 79-525

79-5

CAP

CGP-[illegible]

DEPARTMENT OF HEALTH AND ENVIRONMENT
SOUTHWEST TENNESSEE REGIONAL OFFICE
295 SUMMAR AVENUE
JACKSON, TENNESSEE 38301-3984

October 10, 1985

Mr. John Bandy
International Harvester Co., Inc.
3003 Harvester Lane
Memphis, TN 38127

Re: International Harvester
Acct. # 79525/Acct. #79526
Shelby County

Cle 79-525

Dear John:

Pursuant to our inspection on September 25th and October 2, 1985, implementation of the "Investigation Program and Remedial Action Selection and Implementation Report" appears to be proceeding as scheduled; specifically, the NPDES discharge pipe construction, the general grading of the site to a 4:1 slope and the segregation of the clay and cover materials.

On said dates the IH sites known as the Klinke Ave. Site (acct.#79525) and the S. Riverside Blvd. Site (acct. #79526), respectively were located, identified and catagorized. The Klinke Ave. Site (acct. #79525) is "one in the same" as the Harvester Ave. Site (acct. #79525) and is recorded as such. The Klinke Ave./Harvester Ave. Site is currently catagorized "Remedial Action Underway." The IH-Epic #73 located at 1356 S. Riverside Blvd. (acct. #79526) is the address for the GE/Memphis Lamp Plant (acct. #79524); the correct address for the IH, S. Riverside Blvd. site (acct. #79526) is 300 Olive Street, Memphis, TN. In accordance with our conversations and a site inspection, the IH, 300 Olive Street site (acct. #79526) has no hazardous material on site; therefore the site should not be listed on the Superfund Master list.

Confirmation of the aforementioned information must be submitted to this office in writing to assure the correct categorization and listing of both International Harvester sites. Upon receipt of the confirmation letter the correction will be made and the Division will be notified as such.

Your cooperation and expedience in this matter is greatly appreciated. Should you have any questions, please contact me at (901)424-9200, extension 318.

Sincerely,

Danny Brewer
Environmental Engineer, Superfund
Division of Solid Waste Management

DAB/df 4-5

cc: DSWM, Don Shackelford, Superfund
DSWM, Paul Patterson, Memphis

D H D

1/21

STATE OF TENNESSEE
DEPARTMENT OF HEALTH AND ENVIRONMENT
SOUTHWEST TENNESSEE REGIONAL OFFICE
295 SUMMAR AVENUE
JACKSON, TENNESSEE 38301-3984

December 19, 1985

Mr. Tom Shaffer, Engineer
Velsicol Chemical Corporation
2603 Corporate Avenue
Suite 100
Memphis, Tennessee 38123

Re: Velsicol Chemical Dump
Hardeman County

Dear Mr. Shaffer:

An inspection of Velsicol's Dump in Hardeman County was conducted on December 9, 1985 by George Harvell, Danny Brewer and W. T. Blasingame of the Division of Solid Waste Management. In general the site was in good condition, but some areas of erosion were noted and marked on the attached maps.

The following items need to be addressed:

1. Severe erosion exists in the borrow pit areas of the north disposal site. Erosion is also taking place in the borrow pit area of the middle site.

2. It was understood that the slopes of the cap were to be mowed. This had not taken place at the time of inspection. It is also understood that the cap will be mowed on a regular basis during the forth-coming year.

3. Slight erosion is occurring in the area of the "deer lick". Discretion should be used as to whether this problem needs to be addressed at the present.

4. Pine trees could possibly be utilized for stabilization in steep areas of severe erosion.

5. The entire area should be adequately posted as a disposal site, and it is necessary that a sign be erected listing the dangers associated with the sand pit.

Should you have any questions regarding this letter, please feel free to contact me at 424-9200.

Sincerely,

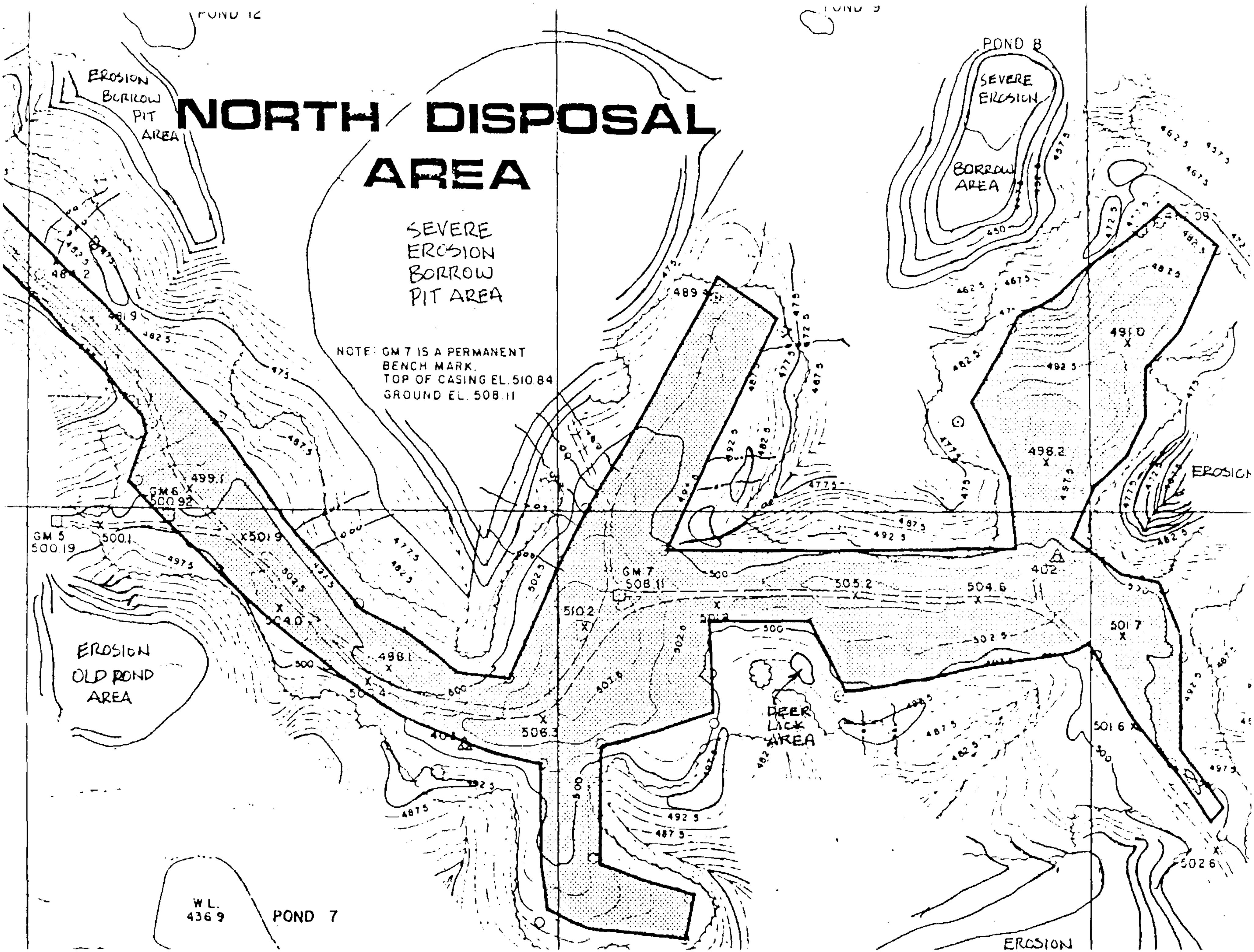
W. T. Blasingame

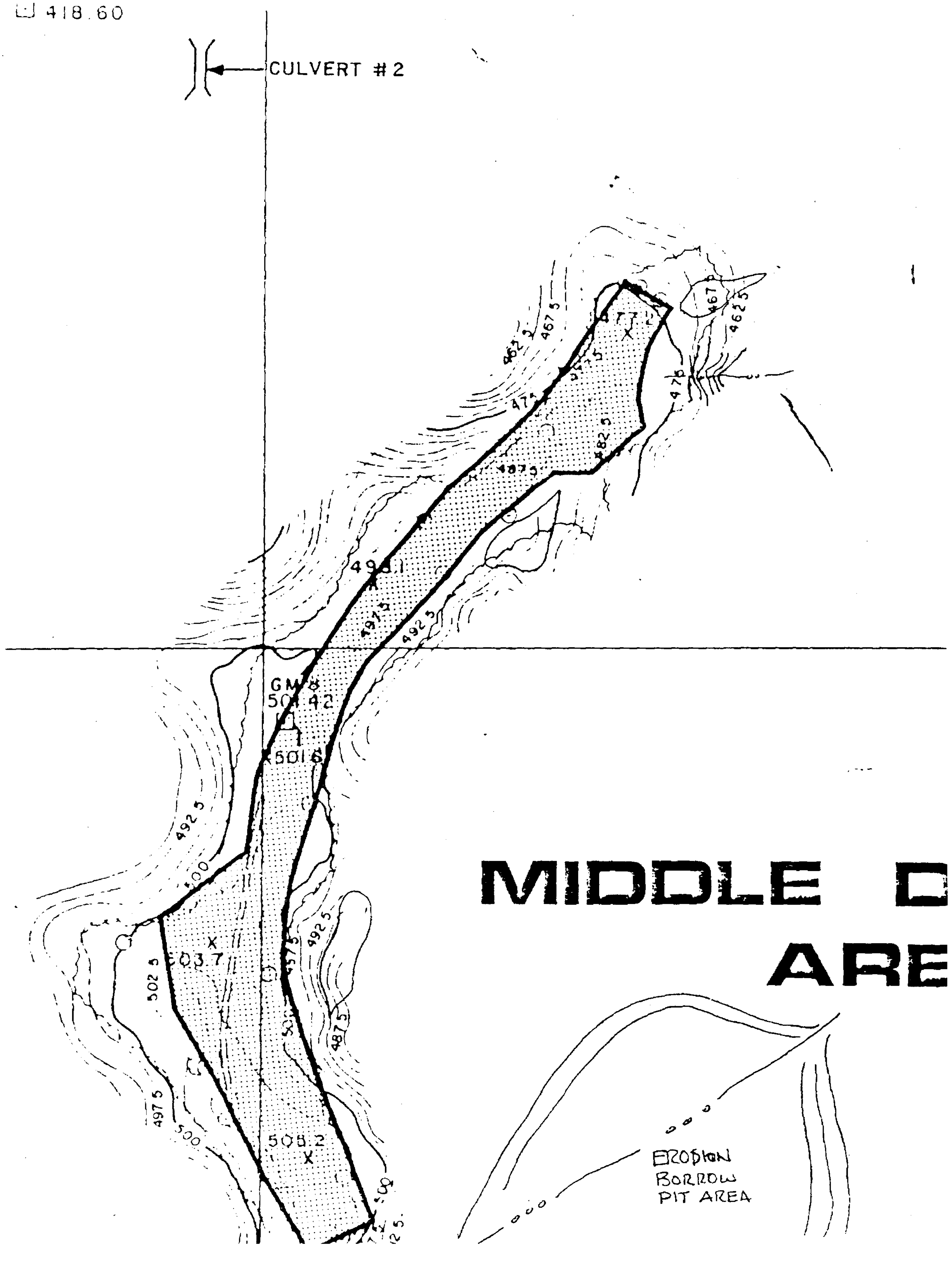
W. T. Blasingame DAB
Environmental Specialist, Superfund
Division of Solid Waste Management

WTB/rc 5-3

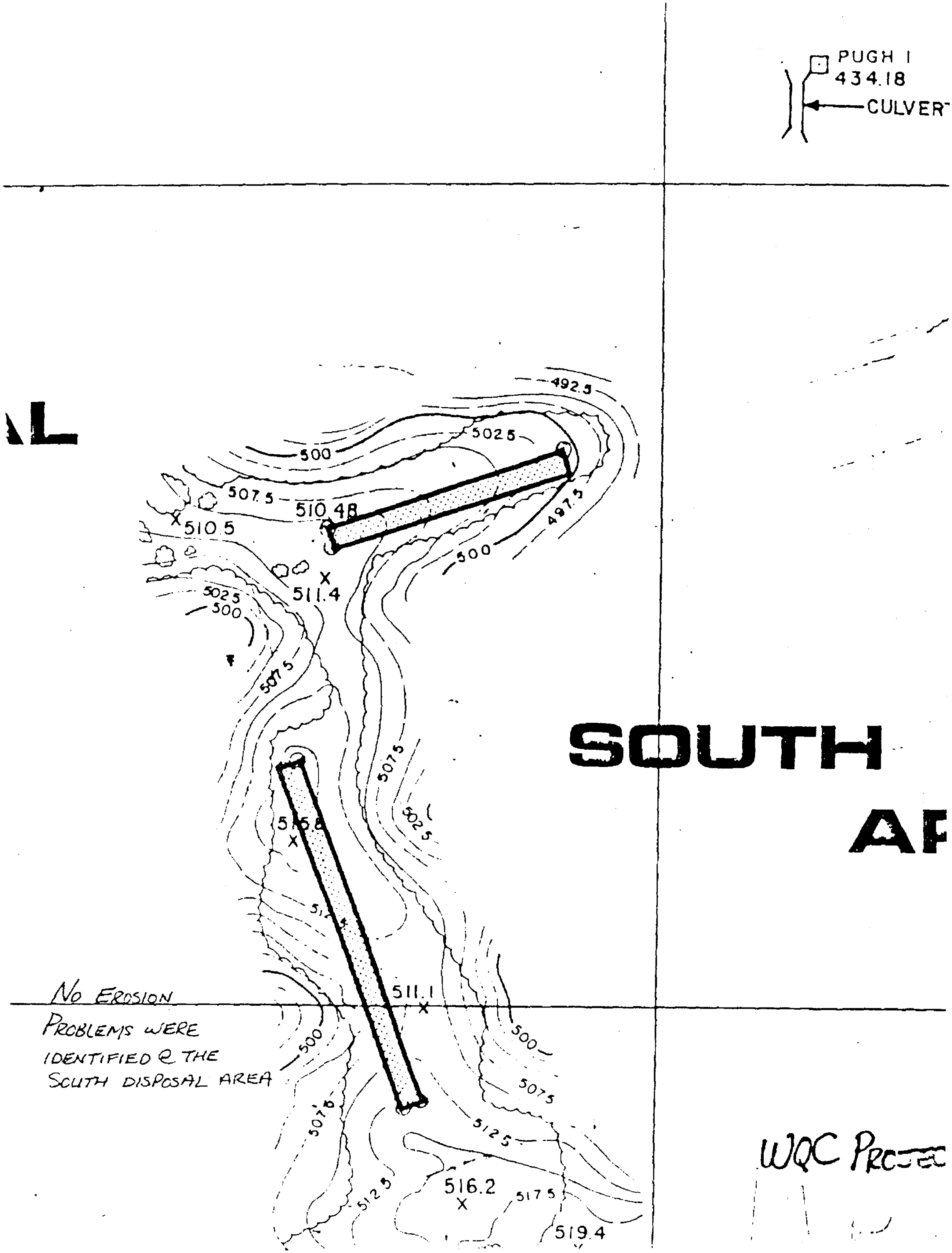
Attachments

cc: DSWM, Nashville, Don Shackelford
DSWM, Jackson, Randy Harris
Mr. Chuck Hanson


NORTH DISPOSAL AREA
SEVERE EROSION BORROW PIT AREA
NOTE: GM 7 IS A PERMANENT BENCH MARK.
TOP OF CASING EL. 510.84
GROUND EL. 508.11
EROSION BORROW PIT AREA
POND 12
POND 9
POND 8
SEVERE EROSION
BORROW AREA
EROSION
EROSION OLD POND AREA
W.L. 436.9
POND 7
DEER LICK AREA
GM 5 500.19
GM 6 500.92
GM 7 508.11
499.1
501.9
498.1
506.3
510.2
505.2
504.6
501.7
501.6
502.6
498.2
491.0
489
402
404



418.60
CULVERT #2
498.1
GM-8
501.42
501.6
503.7
508.2
MIDDLE D
ARE
EROSION
BORROW
PIT AREA



PUGH I
434.18
CULVER
L
492.5
502.5
500
507.5
510.48
510.5
497.5
500
511.4
502.5
500
507.5
SOUTH
507.5
502.5
AR
511.1
No Erosion
Problems were
identified @ the
South disposal area
500
500
507.5
507.5
512.5
WQC Proj
512.5
516.2
517.5
519.4

3

Site No. TND

Reference No. Feasibility STUDY

SOLID WASTE DISPOSAL FACILITY

FEASIBILITY STUDY

Prepared for

INTERNATIONAL HARVESTER
Memphis, Tennessee

March 1982

ENVIRONMENTAL MANAGEMENT
PLANNING & ENGINEERING
METRO CENTER • 151 ATHENS WAY • NASHVILLE, TENNESSEE 37228

FOREWORD

State regulations issued under the authority of the "Tennessee Solid Waste Disposal Act" have been the primary guide for development of this feasibility study. However, the State's study requirements appear based on sanitary landfill disposal of municipal refuse and, as a result, are not necessarily applicable to industrial landfills.

Since this study considers a single industrial plant and only compares continued landfill operation with final closure, the following study requirements are considered inapplicable:

1. Population Density and Trends: Population trends in the Memphis area will have no effect on International Harvester's waste generation schedule.

2. Major Waste Producers in Area: Production of waste by other sources has no influence on International Harvester's operating procedure.

3. Existing Area Disposal Facilities and Collection Services: International Harvester's industrial fill does not compete with existing disposal facilities, and several local collection services are capable of handling the waste quantities generated if necessary.

4. Transportation System for Site Access: On site disposal of waste requires no use of public roads. Removal of trash by commercial contractor would occur on existing roads with negligible effects on traffic.

5. Site Evaluation of Proposed Disposal Area: The existing industrial fill site has been chosen for continued use, so an evaluation of alternative sites is unnecessary.

The State's sanitary landfill design criteria, again related primarily to municipal refuse, are not specifically related to the International Harvester landfill. As a result, several alternative design strategies have been considered in this report:

1. Closure with an impermeable soil cover and a dike to prevent flooding

2. Closure with an impermeable cover only

3. Continued operation with six inches of weekly cover

4. Continued operation with twelve inches of weekly cover

Final design criteria should be developed with the Division of Solid Waste Management before plans and specifications are prepared.

CONCLUSION

The most economical solution for International Harvester is to close and cover its existing landfill without the construction of a dike. Should construction of the dike be required, the option of continuing use becomes more favorable, depending on the amount of weekly cover required and the need for International Harvester to keep the fill open.

Estimated capital and operating expenses for the various design strategies are as follows:

	Initial Cost	Annual Costs
Closure with Dike	$407,000	$36,000
Closure without Dike	244,000	36,000
Continued Operation with Six Inch Cover	286,000	24,200
Continued Operation with Twelve Inch Cover	323,000	34,600

The above costs do not consider International Harvester's expenses for equipment and personnel if continued operation of the landfill is chosen.

Based on International Harvester's maximum anticipated waste generation rate of 200 cubic yards per day (uncompacted), remaining landfill life is 18 years.

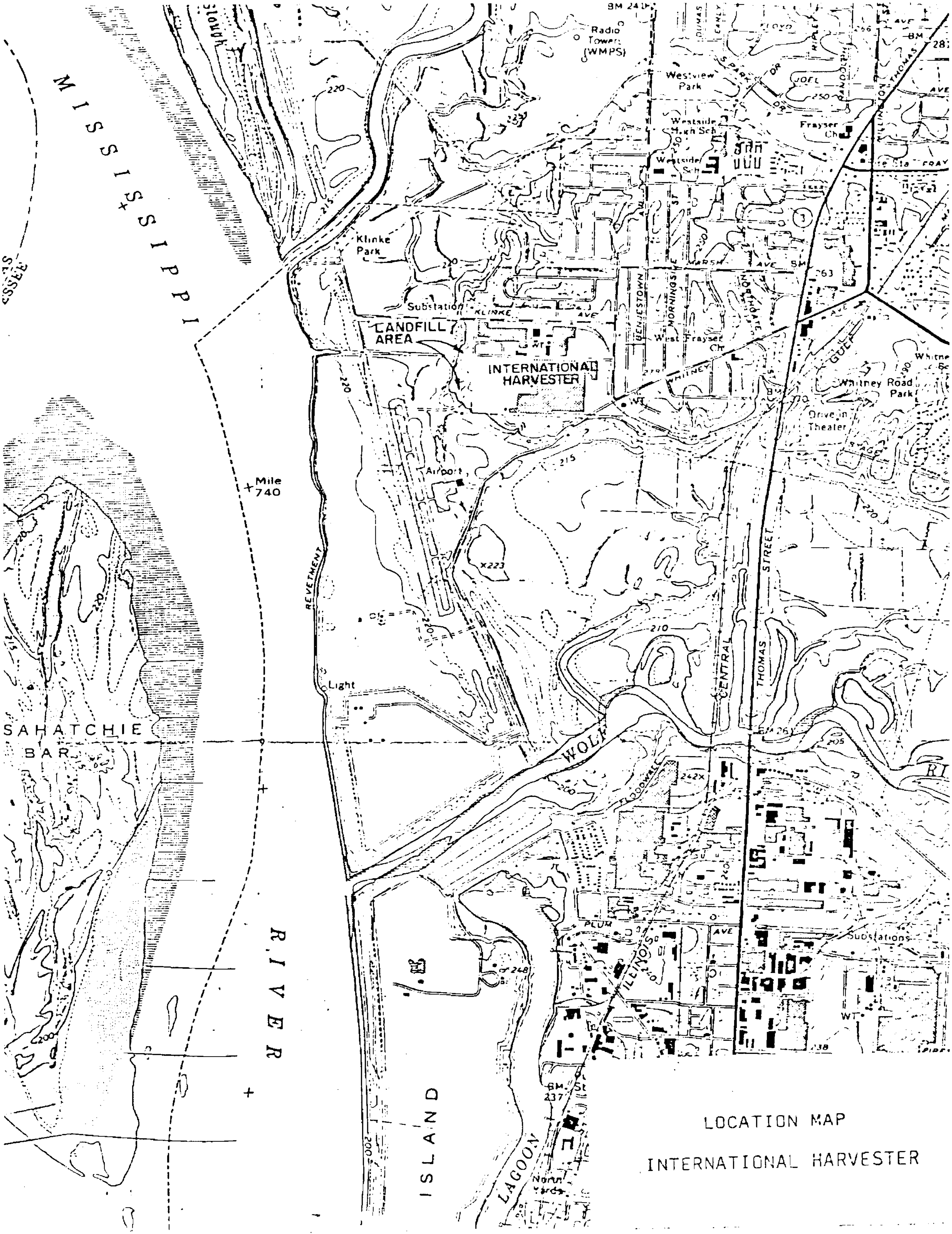
INTRODUCTION

The International Harvester Corporation has been operating a waste disposal site on company property adjacent to its manufacturing operation since the 1940's. (See location map.) At one time, landfilled items included wood, paper, foundry sand, paint sludge, washing machine sludge, oils, greases, coolants, wastewater treatment sludge, and all miscellaneous solid waste generated by the manufacturing operation, with the exception of scrap metal. Before 1970 all combustible material was burned daily. In 1974, oils, coolants, and flowable grease were eliminated from the landfill and are now removed by oil scavengers. Washing machine sludge and paint sludge became a part of the wastewater treatment sludge in 1978, which is disposed of through Chemical Waste Management, Inc., in Marietta, Georgia, at their Emelle, Alabama facility. Their EPA ID Code is ALT000622464. The foundry was closed in February 1981, eliminating foundry sand from the landfilled items.

Material currently landfilled on-site includes only wood, metal banding and wire, cardboard, and other trash generated by plant operation. Past disposal practices, however, have left residues of lead, chromium,and polychlorinated biphenols (PCB's). (See Page 7.)

It has been determined that this disposal site lies in the floodplain and therefore requires protection from possible floodwaters. This feasibility study outlines the protective steps to be taken and will compare the cost of closing the fill to continuing its use.

The International Harvester site is located approximately one-half mile from the Mississippi River in Memphis, Tennessee. The land in this area is mainly flat with some gently sloped hills. A topographic map of the area is found in Appendix A.



LOCATION MAP

INTERNATIONAL HARVESTER

CLOSURE REQUIREMENTS

A determination has been made that the industrial fill site lies in the floodplain and it will be necessary to construct a levee around the site to a height of at least one foot above the 100-year flood level of 233.4 feet above sea level. The design of the levee will be such that it will have a 12-foot minimum crown and side slopes will be constructed at a 3:1 ratio. The levee will be machine compacted and seeded for stability and to aid in erosion prevention.

In addition to the construction of a levee, the existing fill site will receive two feet of compacted cover material to reduce infiltration and provide a surface for vegetation.

The graded areas will have sufficient slope so that ponding will not occur (minimum of two percent). Steep sections will be terraced to prevent erosion. Adequate drainage of surface water will be provided by ditching and berming to intercept and divert runoff from off-site sources.

CONTINUED USE REQUIREMENTS

In the event of continued use, a levee will be required as previously described. Site preparation consisting of grading existing irregularities in waste distribution will be necessary. Cover material should be placed and grading will be done over the entire 10-acre area. The site will initially be divided into two approximately equal five-acre portions. One area will be covered with one foot of compacted soil and seeded and saved for future use. The remaining tract will be developed as the landfill. When capacity is reached, the site will be closed and the remaining section will be developed. Weekly cover will be applied and areas left unworked for greater than 90 days will be seeded.

During operation, sufficient slope (minimum two percent) and drainage shall be maintained to prevent infiltration into fill area. Steep sections shall be terraced to prevent erosion.

Disposal into the fill area will continue until the elevation of the top of the fill is approximately equal to the elevation of the plant site (Elevation 274). Slope of the fill sides should be no greater than 3:1. Upon closure of the fill, two feet of compacted cover material will be applied and seeded.

CHEMICAL CONTAMINATION

A hazardous waste site investigation conducted by EPA on October 20-21, 1980, at the Internatioal Harvester disposal site noted detectable quantities of lead, chromium, and PCB's. Chromium levels in two water samples taken at the site were measured at 0.058 mg/l and 0.104 mg/l. The Drinking Water Standards for chromium limits its concentration to 0.05 mg/l. Lead levels in water samples taken showed the concentration to be less than 0.04 mg/l which is less than the DWS limits of 0.05 mg/l.

Soil and sediment samples taken at the site also indicate detectable levels of lead, chromium, and PCB's. Samples taken at five locations showed a chromium concentration range of 30 to 278 mg/kg and a lead concentration ranging from 57 to 468 mg/kg. PCB's were detected in all soil and sediment samples with concentrations ranging from 180 ug/kg to 18,000 ug/kg.

Review of past disposal practices has found that lead and chromium most likely originated from disposal of paint sludges while the source of PCB's is spent transformer oil. These disposal practices have been discontinued.

Analysis of the EPA water and soil data indicates no significant impact from these hazardous constituents. This conclusion is based on the following observations:

1. Chromium and lead concentrations in the water samples are below or slightly above drinking water standards. Impact on downstream water quality is insignificant considering potential runoff from this site into the Mississippi River (average flow of river at Memphis is reported as 470,000 cubic feet per second). Furthermore, the company's NPDES permit establishes a chromium standard of 1.0 mg/l for discharge from the wastewater treatment facility; no standard has been set for lead.

2. While PCB's are found in the soil in relatively high concentrations, PCB's are insoluble in water and therefore are unlikely to leave the disposal facility. The EPA study did not analyze PCB in the water.

3. Proposed continued operation or closure techniques will better ensure prevention of water leaching through the landfill by cover, capping, and drainage practices.

PROPOSED LEACHATE CONTROL MEASURES

Minimizing surface infiltration is a primary purpose of either continued landfill operation or closure. Typically, a properly designed landfill accomplishes this requirement through two primary methods:

1. Surface waters which might run onto the landfill are routed around the waste facility; precipitation which falls onto the landfill is caused to run off the surface as soon as possible.

2. A relatively impermeable cover is placed over the fill which minimizes the amount of water which may infiltrate through the waste.

Soil available on-site appears suitable for cover materials. The material will be of generally the same type as that used by the City of Memphis to line the sludge lagoons for the North Wastewater Treatment Plant. The coefficient of permeability is estimated as 1×10^{-5} cm/sec. which should be adequate for levee construction, intermediate and final cover. Drainage will be routed around the fill and on-site drainage will be constructed to maximize runoff through sloping and minimize erosion by terracing.

APPENDIX B
CLOSURE COST

Plans				Initial Cost	Annual Cost
1.	Close and Contract Waste Removal (Without Dike)				
	A.	Cover and Stabilize Existing Landfill			
		1.	Site Preparation	$ 2,500	
		2.	Earthwork	148,400	
		3.	Seeding	10,000	
	B.	Cover and Stabilize Unused Area (5 Acres)			
		1.	Earthwork	55,700	
		2.	Seeding	5,000	
	C.	Contract Waste Removal			$36,000
	D.	Contingency (10%)		22,400	
				$244,000	
2.	Close and Contract Waste Removal (With Dike)				
	A.	Dike Construction			
		1.	Earthwork	$145,000	
		2.	Seeding	3,000	
	B.	Cover and Stabilize Existing Fill			
		1.	Site Preparation	2,500	
		2.	Earthwork	148,840	
		3.	Seeding	10,000	
	C.	Cover and Stabilize Unused Area (5 Acres)			
		1.	Earthwork	55,660	
		2.	Seeding	5,000	
	D.	Contract Waste Removal			$36,000
	E.	Contingency		37,000	
				$407,000	

Difference in initial cost is $163,000.

By closing the fill, the annual cost of operating the fill (equipment and man-hours) would be eliminated.

APPENDIX C

COST OF CONSTRUCTING DIKE AND CONTINUING USE IN PRESENT FILL AREA (LIFE ESTIMATED - 18 YEARS)

Plan 2 (6" Intermediate Cover)

		Initial Cost	Annual Cost
1.	Construct Dike		
	a. Earthwork	$145,000	
	b. Seeding	3,000	
2.	Initial Earthwork		
	a. Cover and Close Unused 5-Acre Area (18")	55,700	
	b. Seeding	5,000	
3.	Site Preparation	2,500	
4.	6" Intermediate Cover for 10 Acres	32,300	
5.	Seeding 5 Acres	5,000	
6.	Annual Cover		$10,400
7.	Annual Seeding		5,000
8.	Eventual Closure Cost		8,800
			$24,200
9.	Contingency	37,500	
		$286,000	

To be added is the cost of an operator and equipment for spreading waste.

APPENDIX D

COST OF CONSTRUCTING DIKE AND CONTINUING USE IN PRESENT FILLA REA (LIFE ESTIMATED - 18 YEARS)

Plan 1 (1' Intermediate Cover)

	Initial Cost	Annual Cost
1. Construct Dike		
a. Earthwork	$ 145,000	
b. Seeding	3,000	
2. Initial Earthwork		
a. Cover and Close 5-Acre Unused Area (18")	55,700	
b. Seeding	5,000	
3. Site Preparation	2,500	
4. 1' Intermediate Cover for 10 Acres	64,500	
5. Seeding 5 Acres	5,000	
6. Annual Cover		$ 20,800
7. Annual Seeding		5,000
8. Eventual Closure Cost		8,800
	$ 280,700	$ 34,600
9. Contingency (15%)	42,300	
	$ 323,000	

To be added is the cost of an operator and equipment for spreading waste.

Site No. TND

Reference No. Commissioners order

March 14, 1984

International Harvester Company
c/o C. T. Corporation System
530 Gay Street
Knoxville, Tennessee 37902

Dear Sir:

Enclosed please find a document entitled Commissioner's Order issued by James E. Word against International Harvester Company. I would particularly direct your attention to the Notice of Rights section.

If you have ~~any~~ questions please call me at (615) 741-3657.

Sincerely,

William L. Penny

William L. Penny
Assistant General Counsel

Enclosure

cc: Don Shackelford
Tom Blankenship, Jr.
Jean Inman

3012 file

identify, contain, and clean up, including monitoring and maintenance, inactive hazardous substance sites which pose or may pose a danger to public health, safety or the environment because of the release or threatened release of hazardous substances. Pursuant to T.C.A. Section 68-46-215 the Commissioner may issue an order for correction to the appropriate person, and this order shall be complied with within the time limit specified in the order.

COMMISSIONER'S ORDER

Comes now, James E. Word, Commissioner of the Tennessee Department of Health and Environment, and states that:

PARTIES

I.

James E. Word is the duly appointed Commissioner of the Tennessee Department of Health and Environment (the "Department").

II.

The International Harvester Company (the "Respondent") is a Maryland Corporation qualified to do business in Tennessee. It is doing business at 3003 Harvester Lane, Memphis, Tennessee 38127. Its registered agent for service of process is: C. T. Corporation Systems, 530 Gay Street, Knoxville, Tennessee 37902. The Company manufactures farm equipment and the manufacturing processes include casting, shearing, machining, welding, assembly, washing, plating and painting.

JURISDICTION

III.

Pursuant to T.C.A. Sections 68-46-111 and 68-46-206, the Commissioner is authorized to issue an order to any liable party requiring such party to investigate, identify, contain, and clean up, including monitoring and maintenance, inactive hazardous substance sites which pose or may pose a danger to public health, safety or the environment because of the release or threatened release of hazardous substances. Pursuant to T.C.A. Section 68-46-215 the Commissioner may issue an order for correction to the appropriate person, and this order shall be complied with within the time limit specified in the order.

As part of the Respondents manufacturing process, it produces metal plating wastes containing lead, chromium and other elements. This liquid waste is a hazardous substance as defined in T.C.A. Section 68-46-202. The waste is also a listed hazardous waste as defined in the Tennessee Hazardous Waste Regulation 1200-1-11-.02(4).

VI.

The existence of this inactive hazardous substance site poses or may be reasonably anticipated to pose a danger to public health, safety, and environment. This inactive hazardous substance site appears on the proposed list of such sites (pursuant to T.C.A. Section 68-46-206) eligible for investigation, indentification, containment and clean up.

VII.

The Respondent reported that it has disposed of hazardous waste at a disposal site owned by International Harvester Company and located at latitude and longitude coordinates 35°12'23" and 90°03'05" respectively. The Respondent has reported the disposal of wood, paper, foundry sand, glass metal scraps, cardboard, trash, paint and paint sludge, washing machine sludge, oils, grease, coolants, wastewater treatment sludge, spent transformer oil, varnishes, sealing compounds, caustics and acids, electroplating treatment sludge and miscellaneous industrial solid waste. The disposal site has been inactive since at least November, 1983.

VIII.

On October 20-21, 1980 EPA conducted a hazardous waste site investigation of International Harvester. Analysis of samples taken during this inspection revealed

By operating this disposal site and generating the hazardous substances disposed of in the site, Respondent is a "liable party" as defined in T.C.A. Section 68-46-202 which is defined as:

"(a.) he owner or operator of an inactive hazardous substance site;

(b.) Any person who at the time of disposal was the owner or operator of an inactive hazardous substance site;

(c.) Any generator of hazardous substance who at the time of disposal caused such substance to be disposed of at an inactive hazardous substance site;. . ."

This site is a hazardous substance site within the meaning of T.C.A. Section 68-46-202 which is defined as "any site or area where hazardous substance disposal has occurred."

X.

PREMISES CONSIDERED, I, James E. Word, hereby ORDER the Respondent, International Harvester Company to comply with the following:

A. INITIAL ASSESSMENT

1. Within sixty (60) days of receipt of this Order, the Respondent shall submit to the Department any existing data available to the Respondent which is pertinent to the assessment of the hazard that the specified site may pose to public health and the environment. This information shall include available data listed in paragraph X.B.2 of this Order and shall be submitted in duplicate.

and maintenance. A schedule for future activities, deemed necessary by the Department, shall be established at this conference. Depending on existing data, the Department may determine that no further action is necessary. In all other cases, the schedule established in this conference will provide the dates by which the activities enumerated herein must be completed.

B. <u>INVESTIGATION PROGRAM</u>

1. According to the schedule established in the initial assessment conference, the Respondent shall submit to the Department a proposed Investigation Plan.

2. In order to provide an accurate assessment of the hazard posed by the site to public health and the environment and to develop design data for remedial action, the Investigation Plan shall include, but not be limited to, assessment of the following factors:

a. Types and quantities of hazardous substances disposed at the site.

b. Physical state, analytical summary, toxicological characteristics and other pertinent data defining hazardous substances present at the site.

c. Methods and extent of the disposal operation including containment methods used, plans and/or photographs of site operation, perimeter and depth of disposal area, and type of disposal operation conducted (open burning, trench, surface impoundment, etc.).

d. Observed release of contaminants to groundwater, surface water or air, including sampling, to determine contaminant concentrations and extent of contaminant migration.

(1.) Groundwater use and population served by groundwater sources within a three (3) mile radius of the perimeter of contaminant migration.

(2.) Surface water use and population served within a three (3) mile reach downstream of the perimeter of contaminant migration.

(3.) Population potentially affected by contaminant releases to the air within a four (4) mile radius of the perimeter of contaminant migration.

(4.) Distance from the site to sensitive environments such as a natural wetland, critical habitat for an endangered species or a National Wildlife Refuge.

g. Fire and explosion hazard assessment of the site.

h. Direct contact hazard assessment of the site.

3. The Investigation Plan must include cost estimates and a proposed schedule for completion of activities involved in the investigation. Following a review of the Plan, the Department may schedule a meeting which Respondent shall attend to discuss any revisions required by the Department. The Respondent will be given seven (7) days notice prior to the meeting. On or before a deadline date established in this review meeting, a revised Investigation Plan shall be submitted by the Respondent to the Department. Upon approval by the Department of the revised Investigation Plan, the Respondent shall begin required activities according to the revised Investigation Plan.

schedule. This report will be referred to as a Hazard Assessment/Remedial Action report (herein after referred to as "HA/RA"). Remedial action alternatives must include cost estimates and proposed schedules for completion of activities involved in remedial action implementation.

2. Assessment of each remedial action alternative must include consideration of the following factors:

a. The technological feasibility of each alternative;

b. The cost-effectiveness of each alternative;

c. The nature of the danger to the public health, safety, and the environment posed by the hazardous substances at the site; and

d. The extent to which each alternative would achieve the goal of T.C.A. Section 68-46-206(d) which states, in part, ". . . The goal of any such action shall be cleanup and containment of the site through the elimination of the threat to public health, safety and the environment posed by the hazardous substance."

3. Following the Department review of the HA/RA Report, the Department will schedule a meeting which the Respondent shall attend, to discuss any revisions required by the Department. The Respondent shall be given seven (7) days notice prior to the meeting. On or before a deadline date established in this review meeting, a revised HA/RA Report shall be submitted to the Department. Upon receipt of approval by the Department of the revised HA/RA Report, the Respondent shall begin activities required by the revised HA/RA Report, unless the Department determines no further action is necessary.

1. Where the Department determines a need for site monitoring and maintenance, the Respondent shall provide a Site Monitoring and Maintenance Plan (herein after referred to as "M/M Plan") which shall include a proposed schedule for completion of required activities and cost estimates within ninety (90) days of receipt of a request for said Plan by the Department.

2. Within forty-five (45) days of receipt of this M/M Plan by the Department, the Respondent shall attend a meeting with the Department to discuss any required revisions. On or before a deadline established in this review meeting, a revised M/M Plan shall be submitted by the Respondent to the Department. Upon receipt of approval by the Department, the revised M/M Plan will go into effect.

E. To the extent practicable, any investigation, identification, containment and clean-up, including monitoring and maintenance, shall be consistent with the national contingency plan promulgated pursuant to Section 105 of Public Law 96-510.

F. Certain activities may be deemed critical by the Department and shall require observation by the Department. The Respondent shall provide sufficient notice to the Department to allow scheduling of personnel for these activities. The Department also reserves the right to observe any other activities required pursuant to this Order.

G. Any failure to comply with approved schedules of activities required under this Order shall be a failure to comply with this Order.

H. In this Order, any reference to the singular includes the plural.

Health and Environment this 14th day of March, 1984.

JAMES E. WORD, Commissioner
Tennessee Department of Health and Environment

NOTICE OF RIGHTS

International Harvester Company is hereby advised that in accordance with T.C.A. Section 68-46-215 it may secure a review of the necessity for or reasonableness of this Order by filing with the Commissioner, a written petition setting forth the grounds and reason for objection and asking for a hearing in the matter involved before the Solid Waste Disposal Control Board. The Order shall become final and not subject to review unless the person or persons named herein shall file such petition for a hearing no later than thirty (30) days after the date such Order is secured. Hearings will be conducted in accordance with the Tennessee Uniform Administrative Procedures Act.

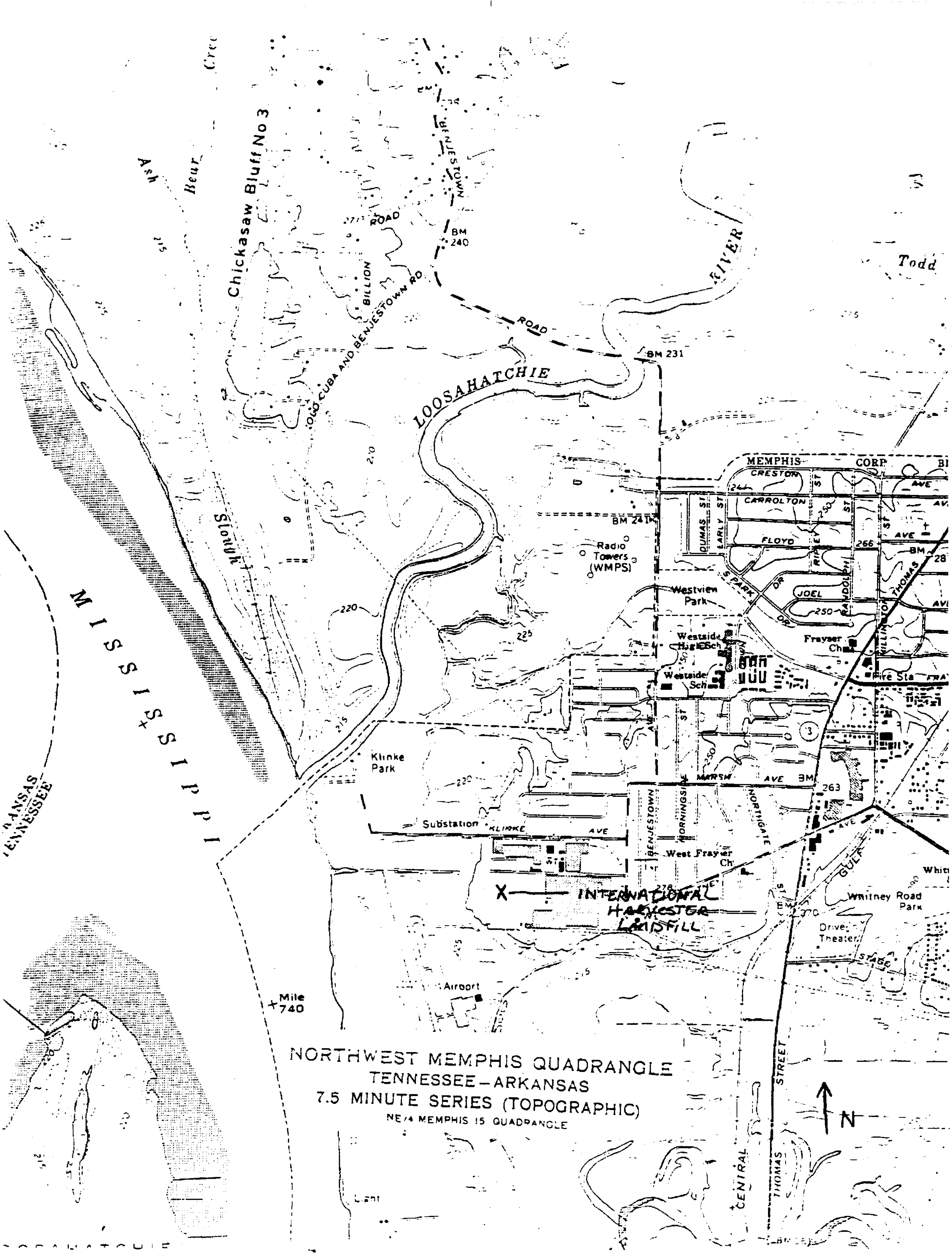
Correspondence regarding this Order should be addressed to William L. Penny, Assistant General Counsel, 150 9th Avenue, North, Nashville, Tennessee 37203 or telephone (615)741-3657.

William L. Penny
Assistant General Counsel

WLP/bec/Intern Harv

Site No. TND

Reference No. Topo map #5



Chickasaw Bluff No 3
BENJESTOWN
BM 240
ROAD
BILLION
OLD CUBA AND BENJESTOWN RD
ROAD
BM 231
RIVER
Todd
LOOSAHATCHIE
Slough
MISSISSIPPI
ARKANSAS
TENNESSEE
MEMPHIS CORP
CRESTON
CARROLTON
FLOYD
DUMAS ST
EARLY ST
BM 241
Radio Towers (WMPS)
S PARK DR
JOEL
RANDOLPH
THOMAS
Westview Park
Westside High Sch
Westside Sch
Frayser Ch
Fire Sta
Klinke Park
MARSH AVE
BM 263
Substation
KLINKE AVE
BENJESTOWN
MORNINGSIDE
NORTHGATE
West Frayser Ch
X
INTERNATIONAL HARVESTER LANDFILL
GULF AVE
Whitney Road Park
Drive-in Theater
STAGE
Airport
Mile 740
Light
CENTRAL
STREET
THOMAS
N
NORTHWEST MEMPHIS QUADRANGLE
TENNESSEE–ARKANSAS
7.5 MINUTE SERIES (TOPOGRAPHIC)
NE/4 MEMPHIS 15 QUADRANGLE

* Update Delete - same as Int. Harv. ~~TND 980558670~~ TND 007024516

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION

01 STATE: TND | 02 SITE NUMBER: 98-055-8670

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site): International Harvester

02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER: Klinke Ave

03 CITY: ~~Klinke Ave.~~ Memphis

04 STATE: TN | 05 ZIP CODE: 38053 | 06 COUNTY: Shelby | 07 COUNTY CODE: 157 | 08 CONG DIST: 08

09 COORDINATES: LATITUDE 35° 12' 35" | LONGITUDE 90° 02 20"

10 DIRECTIONS TO SITE (Starting from nearest public road):

III. RESPONSIBLE PARTIES

01 OWNER (If known): International Harvester

02 STREET (Business, mailing, residential): Klinke

03 CITY: Memphis

04 STATE: TN | 05 ZIP CODE: | 06 TELEPHONE NUMBER: ( )

07 OPERATOR (If known and different from owner): International Harvester

08 STREET (Business, mailing, residential): 3003 Harvester Lane

09 CITY: Memphis

10 STATE: TN | 11 ZIP CODE: 3805 | 12 TELEPHONE NUMBER: (901) 357-5311

13 TYPE OF OWNERSHIP (Check one)
- ☑ A. PRIVATE
- ☐ B. FEDERAL: ____ (Agency name)
- ☐ C. STATE
- ☐ D. COUNTY
- ☐ E. MUNICIPAL
- ☐ F. OTHER: ____ (Specify)
- ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)
- ☐ A. RCRA 3001 DATE RECEIVED: __/__/__ MONTH DAY YEAR
- ☑ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: __/__/__ MONTH DAY YEAR
- ☐ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION
- ☐ YES DATE __/__/__ MONTH DAY YEAR
- ☑ NO

BY (Check all that apply)
- ☐ A. EPA
- ☐ B. EPA CONTRACTOR
- ☐ C. STATE
- ☐ D. OTHER CONTRACTOR
- ☐ E. LOCAL HEALTH OFFICIAL
- ☐ F. OTHER: ____ (Specify)

CONTRACTOR NAME(S): ____

02 SITE STATUS (Check one)
- ☐ A. ACTIVE
- ☐ B. INACTIVE
- ☑ C. UNKNOWN

03 YEARS OF OPERATION: ____ BEGINNING YEAR | ____ ENDING YEAR ☑ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED

Drum Storage - Unknown Materials

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION

Drum Storage - Unknown

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)
- ☑ A. HIGH (Inspection required promptly)
- ☐ B. MEDIUM (Inspection required)
- ☐ C. LOW (Inspect on time available basis)
- ☐ D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT: Z. S. Migut

02 OF (Agency/Organization): International Harvester

03 TELEPHONE NUMBER: (901) 357-5311

04 PERSON RESPONSIBLE FOR ASSESSMENT: [signature]

05 AGENCY: Dept Health + Environ.

06 ORGANIZATION: DSWM 3012

07 TELEPHONE NUMBER: (615) 741-6287

08 DATE: 1 / 17 / 84 MONTH DAY YEAR

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT PART 2 - WASTE INFORMATION

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
TND	98-055-8690

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply)

- ☐ A. SOLID
- ☐ B. POWDER, FINES
- ☐ C. SLUDGE
- ☐ D. OTHER ________ (Specify)
- ☐ E. SLURRY
- ☐ F. LIQUID
- ☐ G. GAS

02 WASTE QUANTITY AT SITE (Measures of waste quantities must be independent)

TONS ________

CUBIC YARDS ________

NO. OF DRUMS ________

03 WASTE CHARACTERISTICS (Check all that apply)

- ☐ A. TOXIC
- ☐ B. CORROSIVE
- ☐ C. RADIOACTIVE
- ☐ D. PERSISTENT
- ☐ E. SOLUBLE
- ☐ F. INFECTIOUS
- ☐ G. FLAMMABLE
- ☐ H. IGNITABLE
- ☐ I. HIGHLY VOLATILE
- ☐ J. EXPLOSIVE
- ☐ K. REACTIVE
- ☐ L. INCOMPATIBLE
- ☐ M. NOT APPLICABLE

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE			
OLW	OILY WASTE			
SOL	SOLVENTS			
PSD	PESTICIDES	Unknown		
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
		Unknown			

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

1) EPA - Potential Hazardous Waste Site Identification + preliminary assessment 1/5/83
2) Notification of Hazardous Waste Site

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 ☐ A. GROUNDWATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: ____________
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ B. SURFACE WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: ____________
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ C. CONTAMINATION OF AIR
03 POPULATION POTENTIALLY AFFECTED: ____________
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ D. FIRE/EXPLOSIVE CONDITIONS
03 POPULATION POTENTIALLY AFFECTED: ____________
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ E. DIRECT CONTACT
03 POPULATION POTENTIALLY AFFECTED: ____________
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ F. CONTAMINATION OF SOIL
03 AREA POTENTIALLY AFFECTED: ____________ (Acres)
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ G. DRINKING WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED: ____________
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ H. WORKER EXPOSURE/INJURY
03 WORKERS POTENTIALLY AFFECTED: ____________
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ I. POPULATION EXPOSURE/INJURY
03 POPULATION POTENTIALLY AFFECTED: ____________
02 ☐ OBSERVED (DATE: ____________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER

II. HAZARDOUS CONDITIONS AND INCIDENTS *(Continued)*

01 ☐ J. DAMAGE TO FLORA — 02 ☐ OBSERVED (DATE: ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ K. DAMAGE TO FAUNA — 02 ☐ OBSERVED (DATE: ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION *(Include name(s) of species)*

01 ☐ L. CONTAMINATION OF FOOD CHAIN — 02 ☐ OBSERVED (DATE: ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ M. UNSTABLE CONTAINMENT OF WASTES *(Spills/runoff/standing liquids/leaking drums)* — 02 ☐ OBSERVED (DATE: ________) ☐ POTENTIAL ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ________ 04 NARRATIVE DESCRIPTION

01 ☐ N. DAMAGE TO OFFSITE PROPERTY — 02 ☐ OBSERVED (DATE: ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

01 ☐ O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs — 02 ☐ OBSERVED (DATE: ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

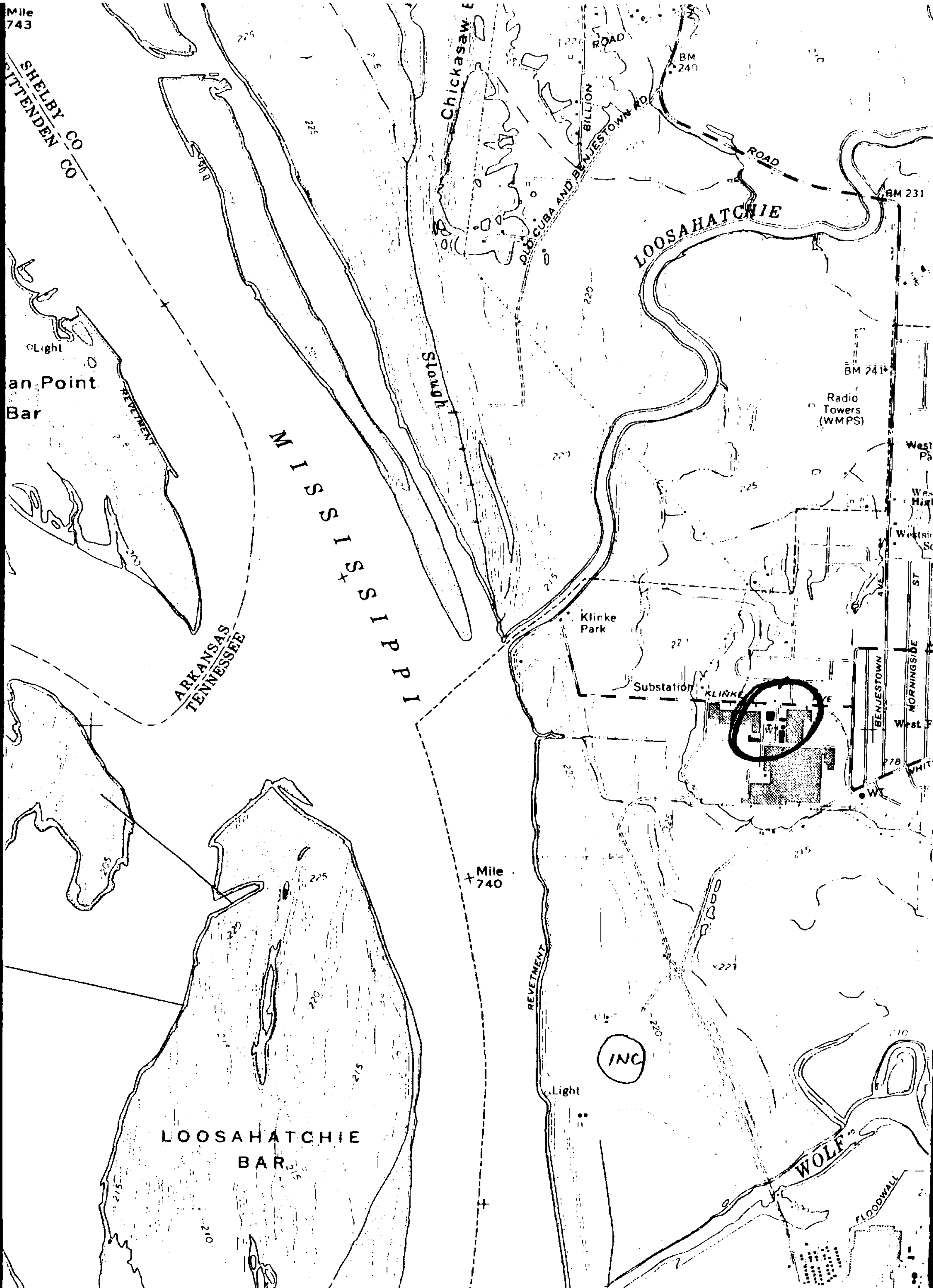
01 ☐ P. ILLEGAL/UNAUTHORIZED DUMPING — 02 ☐ OBSERVED (DATE: ________) ☐ POTENTIAL ☐ ALLEGED
04 NARRATIVE DESCRIPTION

05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

III. TOTAL POPULATION POTENTIALLY AFFECTED: ________

IV. COMMENTS

V. SOURCES OF INFORMATION *(Cite specific references, e. g., state files, sample analysis, reports)*


Mile 743
SHELBY CO
CRITTENDEN CO
Chickasaw
ROAD
BM 240
BILLION
OLD CUBA AND BENJESTOWN RD
ROAD
BM 231
LOOSAHATCHIE
Light
an Point
Bar
REVETMENT
Slough
MISSISSIPPI
BM 241
Radio Towers (WMPS)
Klinke Park
ARKANSAS
TENNESSEE
Substation
KLINKE
BENJESTOWN
MORNINGSIDE
West
Mile 740
REVETMENT
INC
Light
LOOSAHATCHIE BAR
WOLF
FLOODWALL

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION

01 STATE: TND | 02 SITE NUMBER: 007-02-4516

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site): International Harvester - Epic #73

02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER: 3003 Harvester Lane

03 CITY: Memphis

04 STATE: TN | 05 ZIP CODE: | 06 COUNTY: Shelby | 07 COUNTY CODE: 157 | 08 CONG DIST: 08

09 COORDINATES: LATITUDE 35 12 23.0 | LONGITUDE 090 03 05.0

10 DIRECTIONS TO SITE (Starting from nearest public road):

III. RESPONSIBLE PARTIES

01 OWNER (If known): International Harvester Corp

02 STREET (Business, mailing, residential):

03 CITY:

04 STATE: | 05 ZIP CODE: | 06 TELEPHONE NUMBER: (312) 836-2340

07 OPERATOR (If known and different from owner):

08 STREET (Business, mailing, residential):

09 CITY:

10 STATE: | 11 ZIP CODE: | 12 TELEPHONE NUMBER: ( )

13 TYPE OF OWNERSHIP (Check one)

☑ A. PRIVATE ☐ B. FEDERAL: ________ (Agency name) ☐ C. STATE ☐ D. COUNTY ☐ E. MUNICIPAL

☐ F. OTHER: ________ (Specify) ☐ G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)

☑ A. RCRA 3001 DATE RECEIVED: 6 / / 81 (MONTH DAY YEAR) ☐ B. UNCONTROLLED WASTE SITE (CERCLA 103 c) DATE RECEIVED: / / (MONTH DAY YEAR) ☐ C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION

☑ YES DATE 5 / 6 / 83 (MONTH DAY YEAR)
☐ NO

BY (Check all that apply): ☑ A. EPA ☐ B. EPA CONTRACTOR ☐ C. STATE ☐ D. OTHER CONTRACTOR ☐ E. LOCAL HEALTH OFFICIAL ☐ F. OTHER: ________ (Specify)

CONTRACTOR NAME(S):

02 SITE STATUS (Check one): ☑ A. ACTIVE ☐ B. INACTIVE ☐ C. UNKNOWN

03 YEARS OF OPERATION: ____ BEGINNING YEAR | ____ ENDING YEAR ☑ UNKNOWN

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED

Chrome on Steel electroplating process - wastes include Lead & Cr VI

International Harvester has submitted a feasibility study for plant closure to be reviewed by Superfund.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)

☐ A. HIGH (Inspection required promptly) ☐ B. MEDIUM (Inspection required) ☑ C. LOW (Inspect on time available basis) ☐ D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT: E. S. Migut | 02 OF (Agency Organization): International Harvester | 03 TELEPHONE NUMBER: (901) 357-5311

04 PERSON RESPONSIBLE FOR ASSESSMENT: Skip Wrightson | 05 AGENCY: Dept Health | 06 ORGANIZATION: Sec. 3012 | 07 TELEPHONE NUMBER: (615) 741-6287 | 08 DATE: 11 / 21 / 83 (MONTH DAY YEAR)

EPA FORM 2070-12 (7-81)

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT PART 2 - WASTE INFORMATION

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
TND	007-02-4516

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply)

- ☑ A. SOLID
- ☐ B. POWDER, FINES
- ☑ C. SLUDGE
- ☐ D. OTHER ______ (Specify)
- ☐ E. SLURRY
- ☐ F. LIQUID
- ☐ G. GAS

02 WASTE QUANTITY AT SITE (Measures of waste quantities must be independent)

TONS ______

CUBIC YARDS ______

NO. OF DRUMS ______

03 WASTE CHARACTERISTICS (Check all that apply)

- ☑ A. TOXIC
- ☐ B. CORROSIVE
- ☐ C. RADIOACTIVE
- ☐ D. PERSISTENT
- ☐ E. SOLUBLE
- ☐ F. INFECTIOUS
- ☑ G. FLAMMABLE
- ☑ H. IGNITABLE
- ☐ I. HIGHLY VOLATILE
- ☐ J. EXPLOSIVE
- ☐ K. REACTIVE
- ☐ L. INCOMPATIBLE
- ☐ M. NOT APPLICABLE

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE	6000	KG	
OLW	OILY WASTE	Unknown		
SOL	SOLVENTS			
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS			
IOC	INORGANIC CHEMICALS			
ACD	ACIDS			
BAS	BASES			
MES	HEAVY METALS			

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
D007	Chromium VI	7440-47-3	Transfer to Landfill?		
D008	Lead	1335-25-7			

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS			FDS		
FDS			FDS		
FDS			FDS		
FDS			FDS		

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis, reports)

1. Waste Descriptions Book #4 pp 414-416
2. Nashville Office - D.S.W.M. Shelby Co. file 79-115
3. EPA Potential Hazardous Waste Site - Site Inspection Report 6/12/80
4. Generator Notification 8/12/80 pp. (6)

EPA FORM 2070-12 (7-81)

5. International Harvester files Retrieved by Rebecca Harris

EPA

POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 ☐ A. GROUNDWATER CONTAMINATION | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ________ | 04 NARRATIVE DESCRIPTION

01 ☐ B. SURFACE WATER CONTAMINATION | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ________ | 04 NARRATIVE DESCRIPTION

01 ☐ C. CONTAMINATION OF AIR | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ________ | 04 NARRATIVE DESCRIPTION

01 ☐ D. FIRE/EXPLOSIVE CONDITIONS | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ________ | 04 NARRATIVE DESCRIPTION

01 ☐ E. DIRECT CONTACT | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ________ | 04 NARRATIVE DESCRIPTION

01 ☐ F. CONTAMINATION OF SOIL | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 AREA POTENTIALLY AFFECTED: ________ (Acres) | 04 NARRATIVE DESCRIPTION

01 ☐ G. DRINKING WATER CONTAMINATION | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ________ | 04 NARRATIVE DESCRIPTION

01 ☐ H. WORKER EXPOSURE/INJURY | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 WORKERS POTENTIALLY AFFECTED: ________ | 04 NARRATIVE DESCRIPTION

01 ☐ I. POPULATION EXPOSURE/INJURY | 02 ☐ OBSERVED (DATE: ________) | ☐ POTENTIAL | ☐ ALLEGED
03 POPULATION POTENTIALLY AFFECTED: ________ | 04 NARRATIVE DESCRIPTION

EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT

PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER

II. HAZARDOUS CONDITIONS AND INCIDENTS (Continued)

01 ☐ J. DAMAGE TO FLORA — 02 ☐ OBSERVED (DATE: __________) ☐ POTENTIAL ☐ ALLEGED

04 NARRATIVE DESCRIPTION

01 ☐ K. DAMAGE TO FAUNA — 02 ☐ OBSERVED (DATE: __________) ☐ POTENTIAL ☐ ALLEGED

04 NARRATIVE DESCRIPTION (include name(s) of species)

01 ☐ L. CONTAMINATION OF FOOD CHAIN — 02 ☐ OBSERVED (DATE: __________) ☐ POTENTIAL ☐ ALLEGED

04 NARRATIVE DESCRIPTION

01 ☐ M. UNSTABLE CONTAINMENT OF WASTES (Spills/runoff/standing liquids/leaking drums) — 02 ☐ OBSERVED (DATE: __________) ☐ POTENTIAL ☐ ALLEGED

03 POPULATION POTENTIALLY AFFECTED: __________ 04 NARRATIVE DESCRIPTION

01 ☐ N. DAMAGE TO OFFSITE PROPERTY — 02 ☐ OBSERVED (DATE: __________) ☐ POTENTIAL ☐ ALLEGED

04 NARRATIVE DESCRIPTION

01 ☐ O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs — 02 ☐ OBSERVED (DATE: __________) ☐ POTENTIAL ☐ ALLEGED

04 NARRATIVE DESCRIPTION

01 ☐ P. ILLEGAL/UNAUTHORIZED DUMPING — 02 ☐ OBSERVED (DATE: __________) ☐ POTENTIAL ☐ ALLEGED

04 NARRATIVE DESCRIPTION

05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

III. TOTAL POPULATION POTENTIALLY AFFECTED: __________

IV. COMMENTS

V. SOURCES OF INFORMATION (Cite specific references, e. g., state files, sample analysis, reports)

Initial Priority 2

Site No. 73

EPIC Description: Dump and fill of industrial waste behind factory. Several piles of leaking drums. Leachate ponds.

TND 007024516

Facility Name & Location: International Harvester - EPIC #73
3003 Harvester Lane
Shelby Memphis, Tennessee 38127

Contact: Gene Cutrell, Plant Engineer; 901/357-3511

EPA Inspectors: Richard Green & Andrew Kromis

Date & Time of Inspection: 2 MAY 80, 1000

Summary of Field Observations:

International Harvester in Memphis fabricates farm equipment. The plant processes include casting, shearing, machining, welding, assembly, washing, plating, and painting. In addition to manufacturing complete pieces of equipment, the plant also manufactures parts to be shipped to other International Harvester plants.

Site No. 73 is approximately 30 acres located on International Harvester property east of the plant. There were about 1,000 empty drums stacked along the western edge of the site. The original contents of these drums were oil, paint, varnish, sealing compound, caustics, and hydrochloric acid. Most of the drums are sold to Memphis Drum Service to be reconditioned or they are returned to the product manufacturer. Those drums that cannot be sold are supposed to be crushed (but not cleaned) and dumped empty into the landfill. The ground surface down gradient from the drums was oily and black foundry sand is spread out in an area northeast of the drums.

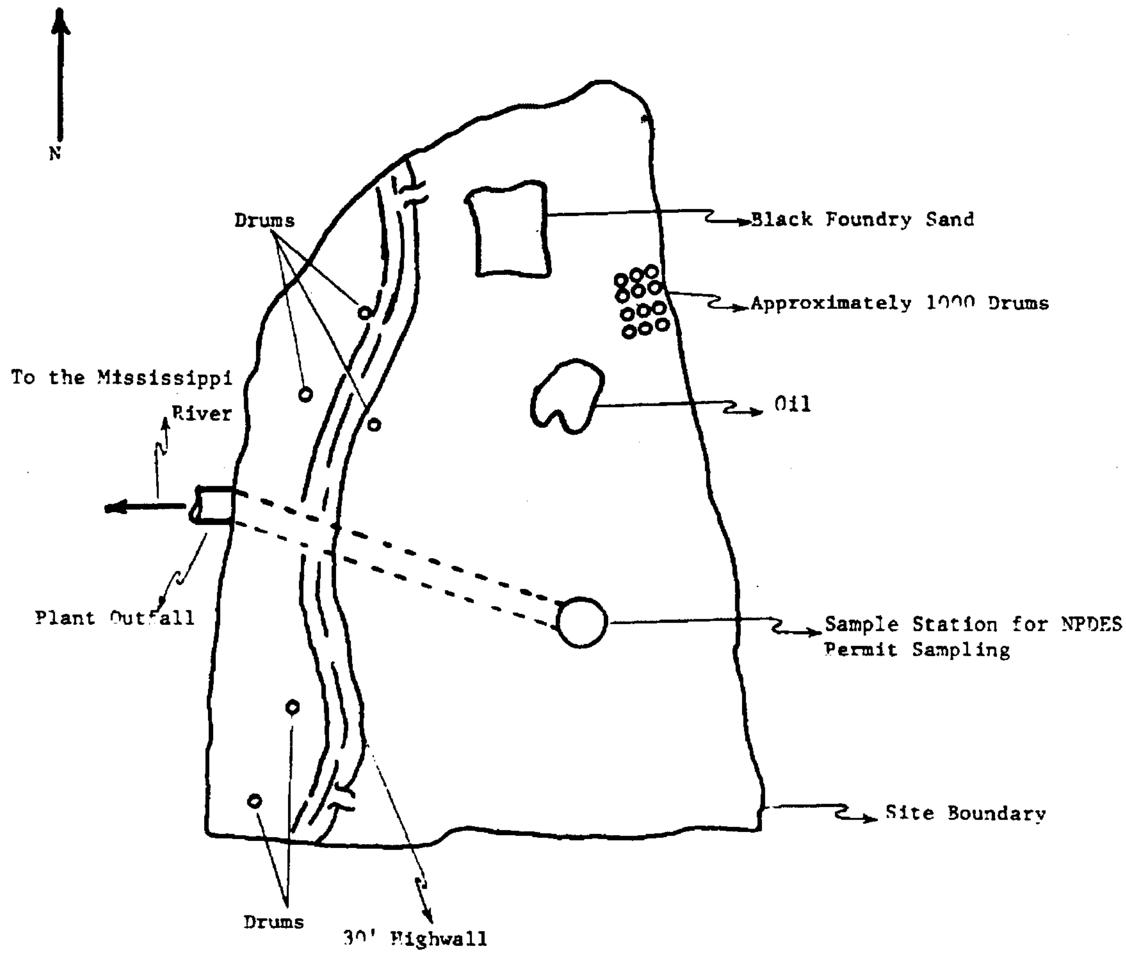
The western edge of site No. 73 is the working face of the International Harvester landfill. The material landfilled consists of wood, pallets, crates, metal, paper trash, glass, and some drums. With the exception of yellow drums filled with trash, the drums in the landfill were supposed to be empty. One drum, originally containing grease, was about three-fourths full, capped and sealed. It was located at the top of the highwall at the edge of the landfill. Other drums originally labelled for oil, paint, cooling compound, and sealant were on the working face of the landfill. These drums were not accessible; therefore, it is not known if they were empty. Other unlabelled drums were seen of which Mr. Cutrell could not identify the contents (or former contents).

Runoff from the landfill probably flows into the area of the plant discharge (see diagram) and then on to the Mississippi River. The plant effluent is sampled for NPDES permit requirements prior to receiving any runoff from the landfill. The plant discharge flows about one half mile through land which is actively being farmed on its way to the Mississippi River. Mr. Cutrell said that the landfill had recently appeared on the front page of the local newspaper with a caption noting leaking chemical drums."

Preliminary Sampling and Coordinating Recommendations:

Sampling of water and sediment in outfall channel below dump, runoff and soils on top of dump, and selected drums in the dump. Coordination with NPDES/Water Sources Team (should NPDES sampling point be moved downstream of dump?)

Site No. 73



N
Drums
Black Foundry Sand
Approximately 1000 Drums
To the Mississippi River
Oil
Plant Outfall
Sample Station for NPDES Permit Sampling
Site Boundary
Drums
30' Highwall

UNITEI ___ TES ENVIRONMENTAL PROTECTI _ AGENCY

DATE: APR ' '80

SUBJECT: International Harvester Company, Hazardous Waste Site Investigation, Memphis, TN. October 20, 1980

FROM: Director, Surveillance and Analysis Division

TO: Howard Zeller, Acting Director
Enforcement Division

Attached is a copy of the subject report. Would you please see that a copy of the report and sample analyses are sent to the International Harvester Company. The plant contact and his address is:

Mr. Gene Cutrell, Plant Engineer
International Harvester
3003 Harvester Lane
Memphis, Tennessee 38127

Billy H. Adams for
James H. Finger

Attachments

cc: Finger/Adams
Lair/Carter
Bennett/Carroll
✓Wilburn
Al Smith/Wayne Mathis
Newton/Turnipseed
Hall/Till

EPA/Region IV
Atlanta, GA
RECEIVED
APR 15 1981
Compliance Branch

HAZARDOUS WASTE SITE INVESTIGATION
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE
MARCH, 1981

INTRODUCTION

A hazardous waste site investigation was conducted at the International Harvester Company, Memphis, TN, during October 20-21, 1980 by J. S. Hall and Charles A. Till of the US Environmental Protection Agency (US-EPA), Region IV, Surveillance and Analysis Division (SAD). This investigation was initiated following a preliminary inspection by personnel of the US-EPA, Region IV, Enforcement Division in May 1980 (1). During the May 1980 inspection, US-EPA, investigators observed wood, pallets, crates, metal, paper, trash, glass, and drums in a landfill adjacent to the plant. The drums in the landfill were alledged to be empty (with the exception of some yellow drums filled with trash), and could not be sold or reconditioned. These drums were not accessible, so their contents or lack thereof were not verified by the US-EPA. The drums that were not sold or reconditioned were supposed to be crushed. There were also approximately 1000 empty drums stacked along the northeastern side of the landfill near the back entrance gate of the plant. The original contents of these drums were reported to be oil, paint, varnish, sealing compound, caustics, and hydrochloric acid.

STUDY AREA

The International Harvester Plant is located at 3003 Harvester Lane on the northwestern side of Memphis (see figure 1). The plant manufactures farm equipment. The manufacturing processes include casting, shearing, machining, welding, assembly, washing, plating, and painting. In addition to manufacturing complete pieces of equipment, the plant also manufactures parts to be shipped to other International Harvester Plants.

The subject landfill is located to the west of the plant. The landfill and adjacent area are situated on the Mississippi River floodplain. All runoff from the landfill drains toward the Mississippi River via a large drainage ditch. The soils around the landfill are floodplain alluvium that consist of materials formed from silts and clays washed from the adjacent uplands, and from silts, clays, sands and gravels deposited by the Mississippi River. The area immediately downgradient from the landfill is presently being farmed. The topography of the area consists of gently sloping uplands to nearly flat to flat bottom lands. (See figure 2 for site map)

During this investigation, four sediment, one soil, and two water samples were collected. Three sediment samples (IH-2, IH-3, IH-4) were collected in depositional areas downgradient from the landfill. A composite soil sample (IH-5) was collected from random locations on top of the landfill. The two water samples IH-6 and IH-001, and another sediment sample IH-7 were collected in the drainage ditch that conveys wastewater from the plant and surface runoff from the landfill to the Mississippi River (see figure 2 for sampling locations). All sampling points were located on International Harvester Company property.

DISCUSSIONS AND RESULTS

The soil and sediment samples were analyzed for organic compounds and metals. Water sample IH-6 was analyzed for organic compounds, metals, and cyanide. Water sample IH-001 was collected for an NPDES inspection so it was analyzed only for metals and other permitted parameters. Results of the NPDES investigation were forwarded January 29, 1981, and are not discussed in this report.

Sampling station locations are included in Table 1. All data included in tables 2 and 3 include only metals and organic compounds that were positively identified and quantified by laboratory analyses. Several organic compounds were tentively identified and concentrations were estimated; also, some trace concentrations (below the minimum detection level (MDL) of organic compounds and metals were detected but were too low to be quantified. These data, along with all of the analytical results, are included with the analytical data sheets in Attachment 1. Attachment 2 contains all of the field data record sheets.

Extractable and Purgeable Organic Compounds

3,4-benzofluoranthene and/or 11,12-benzofluoranthene was detected at a concentration of 1,500 ug/kg in the sediment sample (IH-3) collected in the small drainage ditch on the western side of the landfill. This sample would have been affected by runoff from most of the landfill area except for the northwest portion. Trace concentrations of eight other extractable organic compounds were detected, but were too low to be quantified (<1,000 ug/kg), including: naphthalene, phenanthrene and/or anthracene, fluoranthene, pyrene, chrysene and/or 1,2-benzanthracene, 3,4-benzopyrene, 1,12-benzoperylene, and phenol (<2,200 ug/kg). Also, 13 other extractable organic compounds were tentatively identified in this sample with estimated concentrations or concentrations too low to be quantified. (See Attachment 1).

Sediment sample IH-2, collected in a depositional area collected at the southern part of the site, contained trace concentrations of nine extractable organic compounds but were too low to be quantified (<1,000 ug/ kg). These were: naphthalene, phenanthrene and/or anthracene, fluoranthene, pyrene, 1,2-benzanthracene, 3,4-benzofluoranthene and/or 11,12-benzofluoranthene , 3,4-benzopyrene, 1,12-benzoperylene, and phenol (<500 ug/kg). Ten other extractable organic compounds were tentatively identified with estimated concentrations or concentrations too low to be quantified.

Sediment sample IH-4, collected in a depositional area of the northern part of the site, contained a trace concentration of phenol (<1,000 ug/kg). There were also four other extractable organic compounds tentatively identified with estimated concentrations or concentrations too low to be quantified.

Soil sample IH-5 collected on the landfill, contained trace concentrations of fluoranthene (<15,000 ug/kg) and pyrene (<15,000 ug/kg). Also, one other extractable organic compound was tentatively identified in IH-5, but the concentration was too low to be quantified.

Sediment sample IH-7, collected from the large drainage ditch below the site, contained seven extractable organic compounds that were tentatively identified with estimated concentrations, or concentrations too low to be quantified.

The water sample IH-6, collected from the large drainage ditch below the site, contained no detectable extractable organic compounds.

The only purgeable organic compound detected in any of the soil and sediment or water samples collected during this investigation was dichlorodifluoromethane at a trace concentration (<5 ug/kg) in soil sample IH-4.

Chlorinated Organic Compounds

Polychlorinated biphenyls (PCB's) were detected in all of the soil and sediment samples. The concentrations and compounds were as follows: (IH-2), PCB (Aroclor 1248, 18,000 ug/kg); (IH-3), PCB (Aroclor 1248, 5,500 ug/kg); (IH-4), PCB (Aroclor 1248, 8,900 ug/kg); (IH-5), PCB (Aroclor 1254, 3,800 ug/kg); and (IH-7); PCB (Aroclor 1254, 180 ug/kg). These data indicate that PCB concentrations were higher in the landfill area than in the drainage ditch sediments downgradient from the landfill (see figure 2 and table 2). PCB's have been used in numerous commercial applications such as plasticizers, heat transfer fluids, hydraulic fluids, fluids in vacuum pumps and compressors, lubricants, and wax extenders. (2)

Metals

Iron was detected in all of the soil and sediment samples ranging in concentration from 21,360 ug/kg to 41,000 ug/kg. Sediment sample IH-3 contained lead at a concentration of 112 ug/kg, and zinc at a concentration of 147 ug/kg. Sediment sample IH-4 contained chromium, 141 ug/kg; lead, 468 ug/kg, and zinc, 175 ug/kg. Sediment sample IH-7 contained chromium, 278 ug/kg; lead 210 ug/kg; and zinc, 174 ug/kg. Soil sample IH-5 contained chromium at a concentration of 104 ug/kg. Chromium was detected in water sample IH-6 at a concentration of 104 ug/L. None of the other metals detected in the soil, sediment or water samples displayed high concentrations (3) (See table 2 for concentrations).

METHODOLOGY

All sampling and preservation methods used during this investigation were in accordance with the Water Surveillance Branch Standard Operating Procedures and Quality Assurance Manual, August 29, 1980 (4). Chain-of-custody was maintained from time of collection until samples were relinquished to Laboratory Services Branch (LSB) personnel at the North Treatment Plant in Memphis.

Analyses were conducted by the US-EPA, SAD, Laboratory Services Branch (LSB) and Mead Technology (contract laboratory). The soil, sediment and water samples were analyzed for organic compounds and metals by the (LSB). Water sample IH-6 was analyzed by Mead Technology for organic compounds. The (LSB) analyzed water sample IH-6 for metals and cyanide. Water sample IH-001 was analyzed by the (LSB) for NPDES parameters.

REFERENCES

1. "Report - Hazardous Waste Site Investigation - Memphis, Tennessee - First Phase", US Environmental Protection Agency, Region IV, Enforcement Division; June 1980.

2. Ambient Water Quality Criteria for Polychlorinated Biphenyls United States Environmental Protection Agency, EPA-440/5-80-068, 1980.

3. Hazardous Waste Site Investigation, Frayser Pond Site, Memphis, TN. US Environmental Protection Agency, Region IV, Surveillance and Analysis Division, September 17, 1980.

4. Water Surveillance Branch Standard Operating Procedures and Quality Assurance Manual. (Draft); US Environmental Protection Agency Region IV, Surveillance and Analysis Division, August 29, 1980.

Table 1
Sampling Locations
International Harvester Company
Memphis, Tennessee
March, 1981

Field Identification	SAD No.	Date	Time	Description	Type Sample
IH-2	81C 0103	10/20	1045	Depositional area below the southern most part of landfill.	Sediment
IH-3	81C 0104	10/20	1100	Depositional area below landfill in drainage ditch on western side of site	Sediment
IH-4	81C 0106	10/20	1120	Area below landfill on northern most part of dump.	Sediment
IH-5	81C 0105	10/20	1130 1145	Composite sample from several locations on top of landfill.	Soil
IH-6	81C 0108	10/20	1420	Effluent ditch at culvert and field rd. Approx. 1000 ft. below NPDES discharge pipe.	Water
IH-7	81C 0107	10/20	1425	Effluent ditch at culvert and field rd. Approx. 1000 ft. below NPDES discharge pipe.	Sediment
IH-001	81C 0150	10/21	0935	NPDES outfall in ditch discharging from the plant.	Water

Table 2
Analytical Results
Soil Samples
International Harvester Company
Memphis, Tennessee
March, 1981

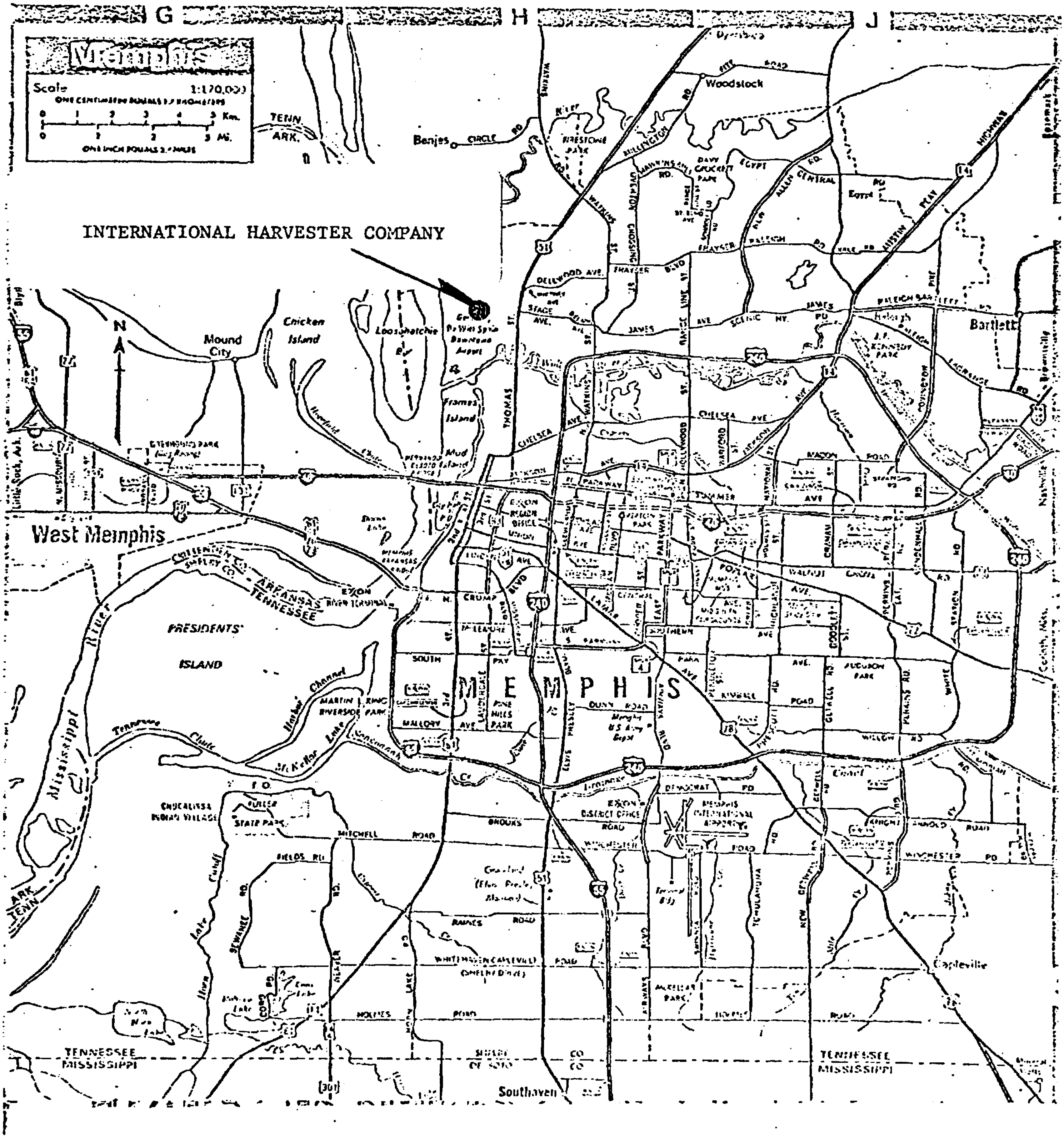
Parameter	Sample Locations				
	IH-2	IH-3	IH-4	IH-5	IH-7
3,4 - benzofluoranthene and/or 11,12 - benzofluoranthene (ug/kg)	ND	1500	ND	ND	ND
Barium (mg/kg)	111	199	316	68	221
Cadmium (mg/kg)	ND	ND	ND	ND	4
Chromium (mg/kg)	30	44	141	104	278
Copper (mg/kg)	26	40	74	50	37
Nickel (mg/kg)	18	31	35	29	33
Lead (mg/kg)	70	112	468	57	210
Strontium (mg/kg)	37	48	92	46	41
Titanium (mg/kg)	275	533	320	112	224
Vanadium (mg/kg)	19	49	27	17	55
Yttrium (mg/kg)	5	11	8	4	14
Zinc (mg/kg)	83	147	175	54	174
Zirconium (mg/kg)	4	ND	5	ND	ND
Mercury (mg/kg)	ND	ND	ND	ND	0.1
Calcium (mg/kg)	17,638	13,170	19,300	6,591	6,050
Magnesium (mg/kg)	5,176	7,497	6,800	2,977	5,350
Aluminum (mg/kg)	7,282	20,985	15,900	6,200	23,750
Iron (mg/kg)	21,360	30,990	41,100	29,680	31,050
Manganese (mg/kg)	502	786	665	426	875
Sodium (mg/kg)	ND	ND	545	390	ND
PCB, (Aroclor 1248) (ug/kg)	18,000	5,500	8,900	ND	ND
PCB, (Aroclor 1254) (ug/kg)	ND	ND	ND	3,800	180

Note: ND - Indicates material was analyzed for but not detected at or above the minimum detection limit.

Table 3
Analytical Results
Water Sample (IH-6) and NPDES Discharge Sample (IH-001)
International Harvester Company
Memphis, Tennessee
March, 1981

Parameter	IH-6	IH-001
	(ug/L)	(ug/L)
Barium	41	38
Chromium	104	58
Copper	14	11
Molybdenum	215	68
Strontium	44	38
Aluminum	300	154
Calcium	13	13
Magnesium	5.9	6
Iron	1.0	0.6
Sodium	17.0	12

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE



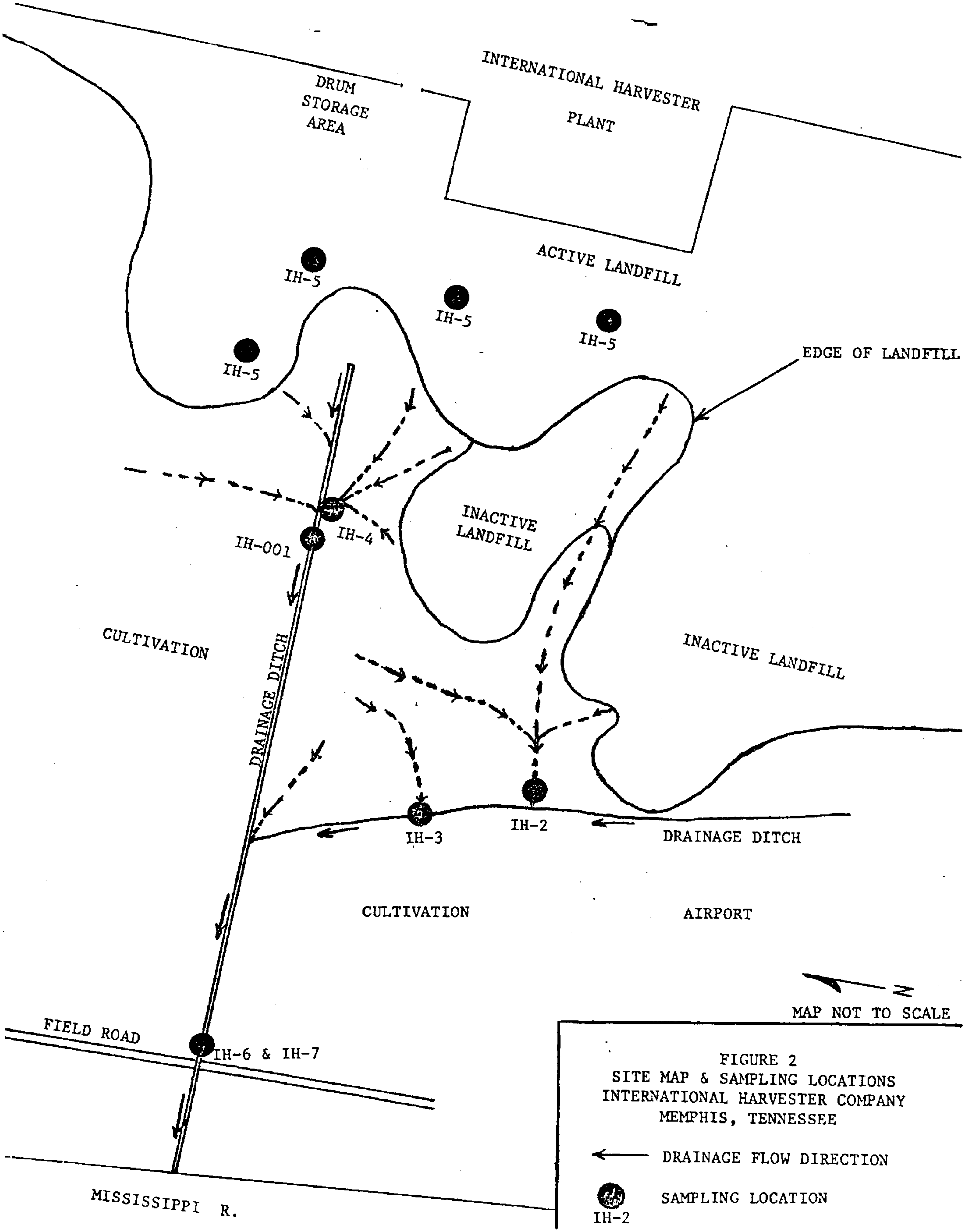


FIGURE 2
SITE MAP & SAMPLING LOCATIONS
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

ATTACHMENT 1

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester
Memphis, TN

CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26-81

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0103		
SOURCE & STATION	IH-2 Depositional area below So. most part of dump.		
DATE/TIME	10-20-80 @ 1045		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
biphenyl 1/	1000K		
dichlorobenzophenone 1/	1000K		
hydroxybenzaldehyde 1/	500K		
C_3 phenol 1/	500K		
C_2 phenol 1/	500K		
tetradecanoic acid, methyl ester 1/	500K		
isobenzofurandione 1/	500K		
pentadecanoic acid, methyl, methyl ester 1/	800J		
octadecenoic acid, methyl ester 1/	900J		
hexadecanoic acid 1/	2700J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 1000 ug/kg

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/ - Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN   CHEMIST E. W. Loy, Jr.   REC'D. 10-20-80   COMPL'D. 1-26-8

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0103		
SOURCE & STATION		IH-2 Depositional area below So. most part of dump.		
DATE/TIME		10-20-80 @ 1045		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	1000U		
26. 1,3-dichlorobenzene	34569	1000U		
27. 1,4-dichlorobenzene	34574	1000U		
18. bis(2-chloroethyl) ether	34276	1000U		
12. hexachloroethane	34399	1000U		
42. bis(2-chloroisopropyl) ether	34286	1000U		
63. N-nitrosodi-n-propylamine	34431	2000U		
56. nitrobenzene	34450	1000U		
52. hexachlorobutadiene	39705	1000U		
8. 1,2,4-trichlorobenzene	34554	1000U		
55. naphthalene	34445	1000K		
43. bis(2-chloroethoxy) methane	34281	1000U		
54. isophorone	34411	2000U		
53. hexachlorocyclopentadiene	34389	1000U		
20. 2-chloronaphthalene	34584	1000U		
77. acenaphthylene	34203	1000U		
1. acenaphthene	34208	1000U		
71. dimethyl phthalate	34344	1000U		
35. 2,4-dinitrotoluene	34614	1000U		
36. 2,6-dinitrotoluene	34629	1000U		
40. 4-chlorophenyl phenyl ether	34644	1000U		
80. fluorene	34384	1000U		
70. diethyl phthalate	34339	1000U		
37. 1,2-diphenylhydrazine 2/	34349	1000U		
62. N-nitrosodiphenylamine 3/	34436	1000U		
9. hexachlorobenzene	39701	1000U		
41. 4-bromophenyl phenyl ether	34639	1000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	1000K		
68. di-n-butyl phthalate	39112	1000U		
39. fluoranthene	34379	1000K		
84. pyrene	34472	1000K		
67. butyl benzyl phthalate	34295	1000U		
5. benzidine	39121	2000U		
66. bis(2-ethylhexyl) phthalate	39102	1000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	1000K		
28. 3,3'-dichlorobenzidine	34634	1000U		
69. di-n-octyl phthalate	34599	1000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	1000K		
73. 3,4-benzopyrene	34250	1000K		
83. indeno (1,2,3-cd) pyrene	34406	1000U		
82. 1,2,5,6-dibenzanthracene	34559	1000U		
79. 1,12-benzoperylene	34524	1000K		
24. 2-chlorophenol	34589	500U		
57. 2-nitrophenol	34594	500U		
65a. phenol (GC/MS)	34695	500K		
34. 2,4-dimethylphenol	34609	500U		
31. 2,4-dichlorophenol	34604	500U		
21. 2,4,6-trichlorophenol	34624	500U		
22. parachlorometa cresol	34455	500U		
59. 2,4-dinitrophenol	34619	4000U		
60. 4,6-dinitro-o-cresol	34660	500U		
64. pentachlorophenol	39061	500U		
58. 4-nitrophenol	34649	1000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.
5/ - Chrysene and/or 1,2-benzanthra
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester
Memphis, TN

CHEMIST E.W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26-81

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0104		
SOURCE & STATION		IH-3 Area below dump ditch on Western side of site.		
DATE/TIME		10-20-80 @ 1100		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	1000U		
26. 1,3-dichlorobenzene	34569	1000U		
27. 1,4-dichlorobenzene	34574	1000U		
18. bis(2-chloroethyl) ether	34276	1000U		
12. hexachloroethane	34399	1000U		
42. bis(2-chloroisopropyl) ether	34286	1000U		
63. N-nitrosodi-n-propylamine	34431	2000U		
56. nitrobenzene	34450	1000U		
52. hexachlorobutadiene	39705	1000U		
8. 1,2,4-trichlorobenzene	34554	1000U		
55. naphthalene	34445	1000K		
43. bis(2-chloroethoxy) methane	34281	1000U		
54. isophorone	34411	2000U		
53. hexachlorocyclopentadiene	34389	1000U		
20. 2-chloronaphthalene	34584	1000U		
77. acenaphthylene	34203	1000U		
1. acenaphthene	34208	1000U		
71. dimethyl phthalate	34344	1000U		
35. 2,4-dinitrotoluene	34614	1000U		
36. 2,6-dinitrotoluene	34629	1000U		
40. 4-chlorophenyl phenyl ether	34644	1000U		
80. fluorene	34384	1000U		
70. diethyl phthalate	34339	1000U		
37. 1,2-diphenylhydrazine 2/	34349	1000U		
62. N-nitrosodiphenylamine 3/	34436	1000U		
9. hexachlorobenzene	39701	1000U		
41. 4-bromophenyl phenyl ether	34639	1000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	1000K		
68. di-n-butyl phthalate	39112	1000U		
39. fluoranthene	34379	1000K		
84. pyrene	34472	1000K		
67. butyl benzyl phthalate	34295	1000U		
5. benzidine	39121	2000U		
66. bis(2-ethylhexyl) phthalate	39102	1000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	1000K		
28. 3,3'-dichlorobenzidine	34634	1000U		
69. di-n-octyl phthalate	34599	1000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	1500		
73. 3,4-benzopyrene	34250	1000K		
83. indeno (1,2,3-cd) pyrene	34406	1000U		
82. 1,2,5,6-dibenzanthracene	34559	1000U		
79. 1,12-benzoperylene	34524	1000K		
24. 2-chlorophenol	34589	2200U		
57. 2-nitrophenol	34594	2200U		
65a. phenol (GC/MS)	34695	2200K		
34. 2,4-dimethylphenol	34609	2200U		
31. 2,4-dichlorophenol	34604	2200U		
21. 2,4,6-trichlorophenol	34624	2200U		
22. parachlorometa cresol	34455	2200U		
59. 2,4-dinitrophenol	34619	11,000U		
60. 4,6-dinitro-o-cresol	34660	2200U		
64. pentachlorophenol	39061	2200U		
58. 4-nitrophenol	34649	4400U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.
4/ -
5/ - Chrysene and/or 1,2-benzanthrace
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

EPA, SAD, RGN. IV
Athens, GA 4/80

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

PROJECT International Harvester Memphis, TN CHEMIST E.W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0104		
SOURCE & STATION	IH-3 Area below dump ditch on Western side of site.		
DATE/TIME	10-20-80 @ 1100		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentratio ug/kg
C_3 alkyl benzene 1/	1000K		
methyl naphthalene (2 isomers) 1/	1000K		
biphenyl 1/	1000K		
C_2 alkyl naphthalene (2 isomers) 1/	1000K		
methyl phenanthrene (2isomers) 1/	1000K		
C_3 alkyl phenol 1/	2200K		
tetradecanoic acid, methyl ester 1/	2200K		
tetradecanoic acid, methyl, methyl ester 1/	2200K		
isobenzofurandione 1/	2200K		
pentadecanoic acid, methyl, methyl ester 1/	5900J		
hexadecanoic acid, methyl, methyl ester 1/	2200K		
octadecenoic acid, methyl ester 1/	5000J		
hexadecanoic acid 1/	7100J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 2500 ug/kg

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/ - Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RCS
Athens, GA

PROJECT International Harvester Memphis, TN — CHEMIST E. W. Loy, Jr. — REC'D. 10-20-80 COMPL'D. 1-

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0105		
SOURCE & STATION		IH-5 Composite of 4 sites from top of dump. 10-20-80 @ 1130		
DATE/TIME		10-20-80 @ 1145		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentr. ug/k
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	15000U		
26. 1,3-dichlorobenzene	34569	15000U		
27. 1,4-dichlorobenzene	34574	15000U		
18. bis(2-chloroethyl) ether	34276	15000U		
12. hexachloroethane	34399	15000U		
42. bis(2-chloroisopropyl) ether	34286	15000U		
63. N-nitrosodi-n-propylamine	34431	30000U		
56. nitrobenzene	34450	15000U		
52. hexachlorobutadiene	39705	15000U		
8. 1,2,4-trichlorobenzene	34554	15000U		
55. naphthalene	34445	15000U		
43. bis(2-chloroethoxy) methane	34281	15000U		
54. isophorone	34411	30000U		
53. hexachlorocyclopentadiene	34389	15000U		
20. 2-chloronaphthalene	34564	15000U		
77. acenaphthylene	34203	15000U		
1. acenaphthene	34208	15000U		
71. dimethyl phthalate	34344	15000U		
35. 2,4-dinitrotoluene	34614	15000U		
36. 2,6-dinitrotoluene	34629	15000U		
40. 4-chlorophenyl phenyl ether	34644	15000U		
80. fluorene	34384	15000U		
70. diethyl phthalate	34339	15000U		
37. 1,2-diphenylhydrazine 2/	34349	15000U		
62. N-nitrosodiphenylamine 3/	34436	15000U		
9. hexachlorobenzene	39701	15000U		
41. 4-bromophenyl phenyl ether	34639	15000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	15000U		
68. di-n-butyl phthalate	39112	15000U		
39. fluoranthene	34379	15000K		
84. pyrene	34472	15000K		
67. butyl benzyl phthalate	34295	15000U		
5. benzidine	39121	30000U		
66. bis(2-ethylhexyl) phthalate	39102	15000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	15000U		
28. 3,3'-dichlorobenzidine	34634	15000U		
69. di-n-octyl phthalate	34599	15000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	15000U		
73. 3,4-benzopyrene	34250	15000U		
83. indeno (1,2,3-cd) pyrene	34406	15000U		
82. 1,2,5,6-dibenzanthracene	34559	15000U		
79. 1,12-benzoperylene	34524	15000U		
24. 2-chlorophenol	34589	500U		
57. 2-nitrophenol	34594	500U		
65a. phenol (GC/MS)	34695	500U		
34. 2,4-dimethylphenol	34609	500U		
31. 2,4-dichlorophenol	34604	500U		
21. 2,4,6-trichlorophenol	34624	500U		
22. parachlorometa cresol	34455	500U		
59. 2,4-dinitrophenol	34619	4000U		
60. 4,6-dinitro-o-cresol	34660	500U		
64. pentachlorophenol	39061	500U		
58. 4-nitrophenol	34649	1000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.

5/ - Chrysene and/or 1,2-benza...
6/ - 3,4-benzofluoranthene and 11,12-benzofluoranthene.

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/8

PROJECT International Harvester CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-2
Memphis, TN

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0105		
SOURCE & STATION	IH-5 Composite of 4 sites from top of dump. 10-20-80 @ 1130		
DATE/TIME	10-20-80 @ 1145		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentrati ug/kg
pentadecanoic acid, methyl, methyl ester 1/	500K		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 15,000 ug/

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/- Tentative identification.

SEDIMENT
DATA REPORTING SHEET
PURGEABLE ORGANIC ANALYSIS

EPA-SAD, [illegible]
ATHENS, GA
4/80

PROJECT International Harvester CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPLET'D 12-19-80
Memphis, TN

BASED ON WET WEIGHT BASIS

SAD NO.		81C 0103	81C 0104	81C 0105
SOURCE & STATION		IH-2 Depositional area below dump.	IH-3 Below dump ditch western side.	IH-5 composite of 4 top.
DATE/TIME		10-20-80 @ 1045	10-20-80 @ 1100	10-20-80@1130-1
Compound		ug/kg	ug/kg	ug/kg
dichlorodifluoromethane 2/	34334	5U	5U	5U
methyl chloride 2/	34421	5U	5U	5U
methyl bromide 2/	34416	5U	5U	5U
vinyl chloride 2/	34495	5U	5U	5U
chloroethane 2/	34314	5U	5U	5U
methylene chloride 2/	34426	5U	5U	5U
trichlorofluoromethane 2/	34491	5U	5U	5U
1,1-dichloroethylene 2/	34504	5U	5U	5U
1,1-dichloroethane 2/	34499	5U	5U	5U
1,2-trans-dichloroethylene 2/	34549	5U	5U	5U
chloroform 2/	34318	5U	5U	5U
1,2-dichloroethane 2/	34534	5U	5U	5U
1,1,1-trichloroethane 2/	34509	5U	5U	5U
carbon tetrachloride 2/	34299	5U	5U	5U
dichlorobromomethane 2/	34330	5U	5U	5U
1,2-dichloropropane 2/	34544	5U	5U	5U
1,3-dichloropropylene 2/	34564	5U	5U	5U
trichloroethylene 2/	34487	5U	5U	5U
benzene 2/	34237	5U	5U	5U
chlorodibromomethane 2/	34309	5U	5U	5U
1,1,2-trichloroethane 2/	34514	5U	5U	5U
2-chloroethyl vinyl ether (mixed) 2/	34579	5U	5U	5U
bromoform 2/	34290	5U	5U	5U
1,1,2,2-tetrachloroethane 2/	34519	5U	5U	5U
tetrachloroethylene 2/	34478	5U	5U	5U
toluene 2/	34483	5U	5U	5U
chlorobenzene 2/	34304	5U	5U	5U
ethylbenzene 2/	34374	5U	5U	5U
acrolein 2/	34213	100U	100U	100U
acrylonitrile 2/	34218	100U	100U	100U
dihydrothiophene 1/		5U	5U	8.1

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
NA - Not analyzed.
1/ - Tentative identification.
2/ - On NRDC List of Priority Pollutants.

EPA-SAD, ... ATHENS, GA 4/80

SEDIMENT
DATA REPORTING SHEET
PURGEABLE ORGANIC ANALYSIS

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPLET'D. 12-19-80

BASED ON WET WEIGHT BASIS

SAD NO.		81C 0103	81C 0104	81C 0105
SOURCE & STATION		IH-2 Depositional area below dump.	IH-3 Below dump ditch western side.	IH-5 composite of 4 top.
DATE/TIME		10-20-80 @ 1045	10-20-80 @ 1100	10-20-80@1130-1
Compound		ug/kg	ug/kg	ug/kg
dichlorodifluoromethane 2/	34334	5U	5U	5U
methyl chloride 2/	34421	5U	5U	5U
methyl bromide 2/	34416	5U	5U	5U
vinyl chloride 2/	34495	5U	5U	5U
chloroethane 2/	34314	5U	5U	5U
methylene chloride 2/	34426	5U	5U	5U
trichlorofluoromethane 2/	34491	5U	5U	5U
1,1-dichloroethylene 2/	34504	5U	5U	5U
1,1-dichloroethane 2/	34499	5U	5U	5U
1,2-trans-dichloroethylene 2/	34549	5U	5U	5U
chloroform 2/	34318	5U	5U	5U
1,2-dichloroethane 2/	34534	5U	5U	5U
1,1,1-trichloroethane 2/	34509	5U	5U	5U
carbon tetrachloride 2/	34299	5U	5U	5U
dichlorobromomethane 2/	34330	5U	5U	5U
1,2-dichloropropane 2/	34544	5U	5U	5U
1,3-dichloropropylene 2/	34564	5U	5U	5U
trichloroethylene 2/	34487	5U	5U	5U
benzene 2/	34237	5U	5U	5U
chlorodibromomethane 2/	34309	5U	5U	5U
1,1,2-trichloroethane 2/	34514	5U	5U	5U
2-chloroethyl vinyl ether (mixed) 2/	34579	5U	5U	5U
bromoform 2/	34290	5U	5U	5U
1,1,2,2-tetrachloroethane 2/	34519	5U	5U	5U
tetrachloroethylene 2/	34478	5U	5U	5U
toluene 2/	34483	5U	5U	5U
chlorobenzene 2/	34304	5U	5U	5U
ethylbenzene 2/	34374	5U	5U	5U
acrolein 2/	34213	100U	100U	100U
acrylonitrile 2/	34218	100U	100U	100U
dihydrothiophene 1/		5U	5U	8J

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
NA - Not analyzed.
1/ - Tentative identification.
2/ - On NRDC List of Priority Pollutants.

SEDIMENT
DATA REPORTING SHEET
PURGEABLE ORGANIC ANALYSIS

[illegible]
ATHENS, GA
4/80

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPLET'D. 12-1[illegible]

BASED ON WET WEIGHT BASIS

SAD NO.		81C 0106	81C 0107	
SOURCE & STATION		IH-4 Below dump northern part.	IH-7 Effluent ditch at Culvert.	
DATE/TIME		10-20-80 1120-1145	10-20-80 1125-1145	
Compound		ug/kg	ug/kg	ug/kg
dichlorodifluoromethane 2/	34334	5K	5[illegible]	
methyl chloride 2/	34421	5U	5[illegible]	
methyl bromide 2/	34416	5U	5U	
vinyl chloride 2/	34495	5U	5U	
chloroethane 2/	34314	5U	5U	
methylene chloride 2/	34426	5U	5U	
trichlorofluoromethane 2/	34491	5U	5U	
1,1-dichloroethylene 2/	34504	5U	5U	
1,1-dichloroethane 2/	34499	5U	5U	
1,2-trans-dichloroethylene 2/	34549	5U	5U	
chloroform 2/	34318	5U	5U	
1,2-dichloroethane 2/	34534	5U	5U	
1,1,1-trichloroethane 2/	34509	5U	5U	
carbon tetrachloride 2/	34299	5U	5U	
dichlorobromomethane 2/	34330	5U	5U	
1,2-dichloropropane 2/	34544	5U	5U	
1,3-dichloropropylene 2/	34564	5U	5U	
trichloroethylene 2/	34487	5U	5U	
benzene 2/	34237	5U	5U	
chlorodibromomethane 2/	34309	5U	5U	
1,1,2-trichloroethane 2/	34514	5U	5U	
2-chloroethyl vinyl ether (mixed) 2/	34579	5U	5U	
bromoform 2/	34290	5U	5U	
1,1,2,2-tetrachloroethane 2/	34519	5U	5U	
tetrachloroethylene 2/	34478	5U	5U	
toluene 2/	34483	5U	5U	
chlorobenzene 2/	34304	5U	5U	
ethylbenzene 2/	34374	5U	5U	
acrolein 2/	34213	100U	100U	
acrylonitrile 2/	34218	100U	100U	

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit
NA - Not analyzed.
1/ - Tentative identification.
2/ - On NRDC List of Priority Pollutants.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN   CHEMIST E. W. Loy, Jr.   REC'D. 10-20-80   COMPL'D. 2-3-81

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0106		
SOURCE & STATION		IH-4 Area below dump on Northern most part of dump.		
DATE/TIME		10-20-80 @ 1120		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	40000U		
26. 1,3-dichlorobenzene	34569	40000U		
27. 1,4-dichlorobenzene	34574	40000U		
18. bis(2-chloroethyl) ether	34276	40000U		
12. hexachloroethane	34399	40000U		
42. bis(2-chloroisopropyl) ether	34286	40000U		
63. N-nitrosodi-n-propylamine	34431	80000U		
56. nitrobenzene	34450	40000U		
52. hexachlorobutadiene	39705	40000U		
8. 1,2,4-trichlorobenzene	34554	40000U		
55. naphthalene	34445	40000U		
43. bis(2-chloroethoxy) methane	34281	40000U		
54. isophorone	34411	80000U		
53. hexachlorocyclopentadiene	34389	40000U		
20. 2-chloronaphthalene	34584	40000U		
77. acenaphthylene	34203	40000U		
1. acenaphthene	34208	40000U		
71. dimethyl phthalate	34344	40000U		
35. 2,4-dinitrotoluene	34614	40000U		
36. 2,6-dinitrotoluene	34629	40000U		
40. 4-chlorophenyl phenyl ether	34644	40000U		
80. fluorene	34384	40000U		
70. diethyl phthalate	34339	40000U		
37. 1,2-diphenylhydrazine 2/	34349	40000U		
62. N-nitrosodiphenylamine 3/	34436	40000U		
9. hexachlorobenzene	39701	40000U		
41. 4-bromophenyl phenyl ether	34639	40000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	40000U		
68. di-n-butyl phthalate	39112	40000U		
39. fluoranthene	34379	40000U		
84. pyrene	34472	40000U		
67. butyl benzyl phthalate	34295	40000U		
5. benzidine	39121	80000U		
66. bis(2-ethylhexyl) phthalate	39102	40000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	40000U		
28. 3,3'-dichlorobenzidine	34634	40000U		
69. di-n-octyl phthalate	34599	40000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	40000U		
73. 3,4-benzopyrene	34250	40000U		
83. indeno (1,2,3-cd) pyrene	34406	40000U		
82. 1,2,5,6-dibenzanthracene	34559	40000U		
79. 1,12-benzoperylene	34524	40000U		
24. 2-chlorophenol	34589	7500U		
57. 2-nitrophenol	34594	7500U		
65a. phenol (GC/MS)	34695	7500K		
34. 2,4-dimethylphenol	34609	7500U		
31. 2,4-dichlorophenol	34604	7500U		
21. 2,4,6-trichlorophenol	34624	7500U		
22. parachlorometa cresol	34455	7500U		
59. 2,4-dinitrophenol	34619	60000U		
60. 4,6-dinitro-o-cresol	34660	7500U		
64. pentachlorophenol	39061	7500U		
58. 4-nitrophenol	34649	15000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/- Tentative identification.
2/- and/or azobenzene.
3/- and/or diphenylamine

5/- Chrysene and/or 1,2-benzanthra
6/- 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RCN. IV
Athens, GA 4/

PROJECT International Harvester Memphis, TN   CHEMIST E. W. Loy, Jr.   REC'D. 10-20-80   COMPL'D 2-3

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0106		
SOURCE & STATION	IH-4 Area below dump on Northern most part of dump.		
DATE/TIME	10-20-80 @ 1120		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentrat ug/kg
1 phenol 1,2 butane diol 1/	7500K	7500K	760
decanoic acid, methyl ester 1/	7500K	7500K	760
hexadecanoic acid, methyl ester 1/	9800J	12,000J	760
octadecanoic acid, methyl ester 1/	9800J	12,000J	760
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 40000 u

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit

1/- Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. I[illegible]
Athens, GA 4/3[illegible]

PROJECT International Harvester
Memphis, TN

CHEMIST E. W. Loy, Jr.

REC'D. 10-20-80 COMPL'D. 2-17-[illegible]

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0107		
SOURCE & STATION		IH-7 Eff. ditch at Culvert at field Rd. below pipe		
DATE/TIME		10-20-80 @ 1426		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	5000U		
26. 1,3-dichlorobenzene	34569	5000U		
27. 1,4-dichlorobenzene	34574	5000U		
18. bis(2-chloroethyl) ether	34276	5000U		
12. hexachloroethane	34399	5000U		
42. bis(2-chloroisopropyl) ether	34286	5000U		
63. N-nitrosodi-n-propylamine	34431	10000U		
56. nitrobenzene	34450	5000U		
52. hexachlorobutadiene	39705	5000U		
8. 1,2,4-trichlorobenzene	34554	5000U		
55. naphthalene	34445	5000U		
43. bis(2-chloroethoxy) methane	34281	5000U		
54. isophorone	34411	10000U		
53. hexachlorocyclopentadiene	34389	5000U		
20. 2-chloronaphthalene	34584	5000U		
77. acenaphthylene	34203	5000U		
1. acenaphthene	34205	5000U		
71. dimethyl phthalate	34344	5000U		
35. 2,4-dinitrotoluene	34614	5000U		
36. 2,6-dinitrotoluene	34629	5000U		
40. 4-chlorophenyl phenyl ether	34644	5000U		
80. fluorene	34384	5000U		
70. diethyl phthalate	34339	5000U		
37. 1,2-diphenylhydrazine 2/	34349	5000U		
62. N-nitrosodiphenylamine 3/	34436	5000U		
9. hexachlorobenzene	39701	5000U		
41. 4-bromophenyl phenyl ether	34639	5000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	5000U		
68. di-n-butyl phthalate	39112	5000U		
39. fluoranthene	34379	5000U		
84. pyrene	34472	5000U		
67. butyl benzyl phthalate	34295	5000U		
5. benzidine	39121	10000U		
66. bis(2-ethylhexyl) phthalate	39102	5000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	5000U		
28. 3,3'-dichlorobenzidine	34634	5000U		
69. di-n-octyl phthalate	34599	5000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	5000U		
73. 3,4-benzopyrene	34250	5000U		
83. indeno (1,2,3-cd) pyrene	34406	5000U		
82. 1,2,5,6-dibenzanthracene	34559	5000U		
79. 1,12-benzoperylene	34524	5000U		
24. 2-chlorophenol	34589	2100U		
57. 2-nitrophenol	34594	2100U		
65a. phenol (GC/MS)	34695	2100U		
34. 2,4-dimethylphenol	34609	2100U		
31. 2,4-dichlorophenol	34604	2100U		
21. 2,4,6-trichlorophenol	34624	2100U		
22. parachlorometa cresol	34455	2100U		
59. 2,4-dinitrophenol	34619	17000U		
60. 4,6-dinitro-o-cresol	34660	2100U		
64. pentachlorophenol	39061	2100U		
58. 4-nitrophenol	34649	4200U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/- Tentative identification.
2/- and/or azobenzene.
3/- and/or diphenylamine.
4/- Phenanthrene and/or anthracene.
5/- Chrysene and/or 1,2-benzanth[illegible]
6/- 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 47

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 2-

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0107		
SOURCE & STATION	IH-7 Eff. ditch at Culvert at Field Rd. below pipe.		
DATE/TIME	10-20-80 @ 1426		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentrat ug/kg
C_3 alkyl phenol (2 isomers) 1/	2100K		
methyl ester of pentadecanoic acid 1/	2100K		
isobenzo furandione 1/	2100K		
methyl ester of methyl pentadecanoic acid 1/	4800J		
methyl ester of methyl hexadecanoic acid 1/	2100K		
methyl ester of octadecenoic acid 1/	4900J		
hexadecanoic acid 1/	6700J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 5000 ug

J – Estimated value.
K – Actual value is known to be less than value given.
L – Actual value is known to be greater than value given.
U – Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/ – Tentative identification.

DATA REPORTING SHEET
SEDIMENT

EPA-SAD-LSB-4-10-5
.7

PROJECT International Harvester Memphis, TN CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 12-17-80

PROJECT NUMBER 81-6 RESULTS ON DRY WEIGHT BASIS

SAD NO.	810	0107			
SOURCE & STATION		IH-7 Eff. ditch at Culvert at field Rd. below pipe.			
DATE/TIME		10-20-80 1425-1145			
ELEMENT (mg/kg)					
Silver*	01078	3K			
Arsenic*	01003	14K			
Boron	01023				
Barium	01008	221			
Beryllium*	01013	4K			
Cadmium*	01028	4			
Cobalt	01038	8K			
Chromium*	01029	278			
Copper*	01043	37			
Molybdenum	01063	8K			
Nickel*	01068	33			
Lead*	01052	210			
Antimony*	01098	10K			
Selenium*	01148	16K			
Tin	01103	24K			
Strontium	01083	41			
Tellurium	45513	16K			
Titanium	01153	224			
Thallium*	34480	40K			
Vanadium	01088	55			
Yttrium	45514	14			
Zinc*	01093	174			
Zirconium	01163	4K			
Mercury*	71921	0.1			
Calcium	00917	6050			
Magnesium	00924	5350			

- CONTINUED ON BACK -

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

- CONTINUATION -
DATA REPORTING SHEET
SEDIMENT

EPA-SAD-LSB-4-10-

PROJECT International Harvester Memphis, TN

CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 12-17-80

PROJECT NUMBER 81-6

RESULTS ON DRY WEIGHT BASIS

SAD NO.						
SOURCE & STATION						
DATE/TIME						
ELEMENT (mg/kg)						
Aluminum	01108	23750				
Iron	01170	31050				
Manganese	01053	875				
Sodium	00934	400K				
Cyanide*(Wet Weight)	00721					
Percent Moisture (%)		33				
Asbestos *	34228	NA	NA	NA	NA	

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

EPA, SAD, LSB
8/22/80

WATER
DATA REPORTING SHEET

SAD NO. RIC 0108 CONTRACT LAB NO. D0212 CONTRACT LAB Mead Technology
PROJECT International Harvester SOURCE & STATION IH-6 Eff. Ditch at Culvert at
Memphis, TN Field Road below pipe.
DATE/TIME SAMPLED 10-20-80 @ 1420 SAMPLE RECEIVED 10-20-80 DATA RECEIVED 12-17-80

VOLATILE COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L	TENTATIVELY-IDENTIFIED COMPOUNDS	ug/L
2V	Acrolein	34210	100U	The chromatogram indicates the	
3V	Acrylonitrile	34215	100U	presence of a petroleum-type	
4V	Benzene	34030	10U	product.	
6V	Carbon Tetrachloride	32102	10U		
7V	Chlorobenzene	34301	10U		
10V	1,2-Dichloroethane	32103	10U		
11V	1,1,1-Trichloroethane	34506	10U		
13V	1,1-Dichloroethane	34496	10U		
14V	1,1,2-Trichloroethane	34511	10U		
15V	1,1,2,2-Tetrachloroethane	34516	10U		
16V	Chloroethane	34311	10U		
19V	2-Chloroethylvinyl Ether	34576	10U		
23V	Chloroform	32106	10U		
29V	1,1-Dichloroethylene	34501	10U		
30V	1,2-Trans-Dichloroethylene	34546	10U		
32V	1,2-Dichloropropane	34541	10U		
33V	1,3-Dichloropropylene	34561	10U		
38V	Ethylbenzene	34371	10U		
44V	Methylene Chloride	34423	10U		
45V	Methyl Chloride	34418	10U		
46V	Methyl Bromide	34413	10U		
47V	Bromoform	32104	10U		
48V	Dichlorobromomethane	32101	10U		
49V	Trichlorofluoromethane	34488	10U		
50V	Dichlorodifluoromethane	34668	10U		
51V	Chlorodibromomethane	34306	10U		
85V	Tetrachloroethylene	34475	10U		
86V	Toluene	34010	10U		
87V	Trichloroethylene	39180	10U		
88V	Vinyl Chloride	39175	10U		

PESTICIDES/PCB'S ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
89P	Aldrin	39330	0.10U
90P	Dieldrin	39380	0.10U
91P	Chlordane (Tech. Mixture & Metabolites)	39350	0.10U
92P	4,4'-DDT (p,p'-DDT)	39300	0.10U
93P	4,4'-DDE (p,p'-DDE)	39320	0.10U
94P	4,4'-DDD (p,p'-TDE)	39310	0.10U
95P	a-Endosulfan-Alpha	34361	0.10U
96P	b-Endosulfan-Beta	34356	0.10U
97P	Endosulfan Sulfate	34351	0.10U
98P	Endrin	39390	0.10U
99P	Endrin Aldehyde	34366	0.10U
100P	Heptachlor	39410	0.10U
101P	Heptachlor Epoxide	39420	0.10U
102P	a-BHC-Alpha	39337	0.10U
103P	b-BHC-Beta	39338	0.10U
104P	γ-BHC-(Lindane)-Gamma	39340	0.10U
105P	Δ-BHC-Delta	34259	0.10U
106P	PCB-1242 (Aroclor 1242)	39496	0.10U
107P	PCB-1254 (Aroclor 1254)	39504	0.10U
108P	PCB-1221 (Aroclor 1221)	39488	0.10U
109P	PCB-1232 (Aroclor 1232)	39492	0.10U
110P	PCB-1248 (Aroclor 1248)	39500	0.10U
111P	PCB-1260 (Aroclor 1260)	39508	0.15U
112P	PCB-1016 (Aroclor 1016)	34671	0.10U
113P	Toxaphene	39400	0.40U
129P	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	34675	NA

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.

5/22/80

WATER
DATA REPORTING SHEET

SAD NO. 81C0108 CONTRACT LAB NO. D0212 CONTRACT LAB Mead Technology
PROJECT International Harvester SOURCE & STATION IH-6 EFF, Ditch at Culvert at
Memphis, TN Field Road below pipe.
DATE/TIME SAMPLED 10-20-80 @ 1420 SAMPLE RECEIVED 10-20-80 DATA RECEIVED 12-17-80

BASE/NEUTRAL COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
1B	Acenaphthene	34205	10U
5B	Benzidine	39120	10U
8B	1,2,4-Trichlorobenzene	34551	10U
9B	Hexachlorobenzene	39700	10U
12B	Hexachloroethane	34396	10U
17B	Bis(Chloromethyl) Ether	34268	NA
18B	Bis(2-Chloroethyl) Ether	34273	10U
20B	2-Chloronaphthalene	34581	10U
25B	1,2-Dichlorobenzene	34536	10U
26B	1,3-Dichlorobenzene	34566	10U
27B	1,4-Dichlorobenzene	34571	10U
28B	3,3'-Dichlorobenzidine	34631	10U
35B	2,4-Dinitrotoluene	34611	10U
36B	2,6-Dinitrotoluene	34626	10U
37B	1,2-Diphenylhydrazine 1/	34346	10U
39B	Fluoranthene	34376	10U
40B	4-Chlorophenyl Phenyl Ether	34641	10U
41B	4-Bromophenyl Phenyl Ether	34636	10U
42B	Bis(2-Chloroisopropyl) Ether	34283	10U
43B	Bis(2-Chloroethoxy) Methane	34278	10U
52B	Hexachlorobutadiene	39702	10U
53B	Hexachlorocyclopentadiene	34386	10U
54B	Isophorone	34408	10U
55B	Naphthalene	34696	10U
56B	Nitrobenzene	34447	10U
61B	N-Nitrosodimethylamine	34438	NA
62B	N-Nitrosodiphenylamine 2/	34433	10U
63B	N-Nitrosodi-N-Propylamine	34428	10U
66B	Bis(2-Ethylhexyl) Phthalate	39100	50U
67B	Butyl Benzyl Phthalate	34292	10U
68B	Di-N-Butylphthalate	39110	10U
69B	Di-N-Octylphthalate	34596	10U
70B	Diethylphthalate	34336	10U
71B	Dimethylphthalate	34341	10U
72B	Benzo (A) Anthracene 4/	34526	10U
73B	Benzo(A) Pyrene	34247	10U
74B	3,4-Benzofluoranthene 5/	34230	10U
75B	Benzo(K) Fluoranthene 5/	34242	10U
76B	Chrysene 4/	34320	10U
77B	Acenaphthylene	34200	10U
78B	Anthracene 3/	34220	10U
79B	Benzo(GHI) Perylene	34521	25U
80B	Fluorene	34381	10U
81B	Phenanthrene 3/	34461	10U
82B	Dibenzo(A, H) Anthracene	34556	25U
83B	Indeno (1,2,3-CD) Pyrene	34403	25U
84B	Pyrene	34469	25U

ACID COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
21A	2,4,6-Trichlorophenol	34621	25U
22A	P-Chloro-m-Cresol	34452	25U
24A	2-Chlorophenol	34586	25U
31A	2,4-Dichlorophenol	34601	25U
34A	2,4-Dimethylphenol	34606	25U
57A	2-Nitrophenol	34591	25U
58A	4-Nitrophenol	34646	25U
59A	2,4-Dinitrophenol	34616	250U
60A	4,6-Dinitro-o-Cresol	34657	250U
64A	Pentachlorophenol	39032	25U
65A	Phenol (GC/MS)	34694	25U

K - Actual value is known to be less than value given.
U - Material was analyzed for but not detected. The number is the minimum detection limit.
1/ - And/or Azobenzene.
2/ - And/or Diphenylamine.
3/ - 81B Phenanthrene and/or 78B Anthracene.

DATA REPORTING SHEET
WATER

EPA-SAD-LSB 4-10-80

PROJECT International Harvester Memphis, TN CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 11-20-80

PROJECT No. 81-6

SAD NO. 81-C	0103			
SOURCE & STATION	IH-6 EFF Ditch at Culvert and Field Rd. Below Pipe.			
DATE/TIME	10-20-80 @ 1420-1145			
ELEMENT (ug/L)				
Silver * 01077	10K			
Arsenic * 01002	45K			
Boron 01022	---			
Barium 01007	41			
Beryllium * 01012	10K			
Cadmium * 01027	10K			
Cobalt 01037	20K			
Chromium * 01034	104			
Copper * 01042	14			
Molybdenum 01062	215			
Nickel * 01067	35K			
Lead * 01051	40K			
Antimony * 01097	25K			
Selenium * 01147	40K			
Tin 01102	60K			
Strontium 01082	44			
Tellurium 01064	40K			
Titanium 01152	10K			
Thallium * 01059	100K			
Vanadium 01087	10K			
Yttrium 01203	10K			
Zinc * 01092	---			
Zirconium 01162	10K			
Mercury * 71900	0.2K			
Aluminum 01105	300			
Manganese 01055	50K			

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

(Continued on Back)

EPA-SAD-LSB 4-10-80

DATA REPORTING SHEET
WATER

PROJECT International Harvester Memphis, TN CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 11-20-

PROJECT No. 81-6

SAD NO. 81C	0108			
SOURCE & STATION	IH-6 EFF Ditch at Cluvert and Field Rd. below pipe.			
DATE/TIME	10-20-80 @ 1420-1145			
ELEMENT (mg/L)				
Calcium 00916	13			
Magnesium 00927	5.9			
Iron 74010	1.0			
Sodium 00929	17			
Cyanide * 00720				
Asbestos * 34225	NA	NA	NA	NA

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

DATA REPORTING SHEET
WATER

EPA-SAD-LSB 4-10-80

PROJECT International Harvester
Memphis, TN
CHEMIST B. McDaniel REC'D 10-21-80 COMPL'D 11-20-80

PROJECT No. 81-6

SAD NO.	81C	0150			
SOURCE & STATION		IH-001 NPDES Outfall in ditch downstream.			
DATE/TIME		10-21-80 @ 0935			
ELEMENT (ug/L)					
Silver *	01077	10K			
Arsenic *	01002	45K			
Boron	01022	---			
Barium	01007	38			
Beryllium *	01012	10K			
Cadmium *	01027	10K			
Cobalt	01037	20K			
Chromium *	01034	58			
Copper *	01042	11			
Molybdenum	01062	68			
Nickel *	01067	35K			
Lead *	01051	40K			
Antimony *	01097	25K			
Selenium *	01147	40K			
Tin	01102	60K			
Strontium	01082	38			
Tellurium	01064	40K			
Titanium	01152	10K			
Thallium *	01059	100K			
Vanadium	01087	10K			
Yttrium	01203	10K			
Zinc *	01092	---			
Zirconium	01162	10K			
Mercury *	71900	0.2K			
Aluminum	01105	154			
Manganese	01055	50K			

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

DATA REPORTING SHEET
WATER

PROJECT ____ CHEMIST B. McDaniel REC'D 10-21-80 COMPL'D 11-2(
Memphis, TN
PROJECT No. 81-6

SAD NO. 81C	0150			
SOURCE & STATION	IH-001 NPDES Outfall in ditch downstream.			
DATE/TIME	10-21-80 @ 0935			
ELEMENT (mg/L)				
Calcium 00916	13			
Magnesium 00927	6.0			
Iron 74010	0.6			
Sodium 00929	12			
Cyanide * 00720				
Asbestos * 34225	NA	NA	NA	NA

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

US EPA REGION IV SAA DIVISION
LABORATORY SERVICES BRANCH
DATA REPORTING SHEET
81C0103 - 81C0108
PROJECT # 81-6 ***PROG ELEMENT # CSI

·190

·ERNATIONAL HARVESTER

·MPHIS STATE: TN

SAMPLE RECEIVED DATE & 10/20/80 1530

COMPLETED: 12/12/80

STATION	DATE & TIME SAMPLED	SAMPLE TYPE	HG UG/L	METSC	CN MG/L	TOC MG/L	PH PH	TEM DEG C
·IH-6 EFF DITCH W CULVERT & FIELD RD BELOW PIPE	10/20/80- 1420- 10/20/80 1145	AMBWA			.002K	15.0	6.4	25.0

ATTACHMENT 2

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS
Memphis, TN
CONTACT

SAMPLING STATION NO. IH-001
SAMPLING LOCATION NPDES outfall 001 in ditch downstream from sanitary, toilet, contact cooling & non-contact cooling

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☒ IND. ☐ INF. ☒ EFF. ☐ ______ ☒ 24 HR. COMP. AT 30 MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☒ EPA ☐ DISCHARGER ☐ MAN. ☒ AUTO. ☒ TYPE ISCO 1680 H 183022 (:30)
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ______ EQUIP
COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.	0150	0150				BACTERIAL	0
DATE	10/20/80 10/21/80	10/21/80				BOD, COD, TOC	1
TIME	1000 1030	0935				CYANIDE	2
FLOW (MGD) [1]	1.44					METALS	3
TEMPERATURE °C		25				N, P	4
pH		7.3				ORG, O&G, PEST	5
TOT. Cl2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE	←	See below					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME		10/21/80 1030				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs
[2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO CART.	RECEIPT NO.
B. [illegible]	10/21/80	1030	1		

REMARKS AND SKETCHES

Q/1 - 1pt glass metals

(pH meter buffered @ 7.0 - reads on 4, on 10)

pH Buffered

4 4.2
7 6.8
10 9.9

1,440,000 gal / 24 hr period

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS
Memphis, TN
CONTACT Gene Cuttrell

SAMPLING STATION NO. IH-2
SAMPLING LOCATION Depositional area below southern outlet part of dump

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT SAMPLE ☐ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP
COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE 1/2	
SAD NO.		0103				BACTERIAL	0
DATE	/	10/20/80				BOD, COD, TOC	1
TIME	/	1045				CYANIDE	2
FLOW ( ) 1/						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, OBS, PEST	5
TOT. Cl2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		See below					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME		10/20/80 1200				PRESERVED	P

1/ Use Avg. Flow for Composites and Inst. Flow for Grabs — 1/2 Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO CART.	RECEIPT NO.
Bob Quinn	10/20/80	1530	2		

REMARKS AND SKETCHES

1-1qt glass - organics < ext R / VOA R

1-1pt ~~glass~~ plastic - metals R — dup. metals sample collected for IH; ~~see separate field~~ ~~sheet~~

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester

ADDRESS Memphis, TN

CONTACT

SAMPLING STATION NO. IH-3

SAMPLING LOCATION Depositional area below dump - in ditch on western side of site

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.

SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP

COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0164				BACTERIAL	0
DATE		10/20/80				BOD, COD, TOC	1
TIME		1100				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, O&G, PEST	5
TOT. Cl_2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		See below					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME		10/20/80 1200				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs [2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
Bob [illegible]	10/20/80	1530	2		

REMARKS AND SKETCHES

1 - 1qt glass - organics < ext F / VOA F

1 - 1qt plastic - metals F (metals dupl. collected for IH)

* G P O 1980 - 640-198 / 1988, REGION NO. 4

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester	SAMPLING STATION NO. IH-4
ADDRESS Memphis TN	SAMPLING LOCATION Depositional area below dump on northernmost part of dump (South of NPDES ditch); sample area drains to NPDES ditch
CONTACT Gene Cuttrell	

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ ____ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.

SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ____

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP ____

COMPUTED FROM ____

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0166				BACTERIAL	0
DATE	/ /	10/20/80				BOD, COD, TOC	1
TIME	/ /	1120				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, O&G, PEST	5
TOT. Cl2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		See below					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME	/	10/20/80 1201				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs   [2] Circle or indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO CART.	RECEIPT NO.
[illegible]	10/20/80	15:30	2		

REMARKS AND SKETCHES

1 - 1qt glass - organics < ext. R / VOA R

1 - 1pt plastic - metals. R (dupl metals collected for IH)

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV | ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis TN
CONTACT Gene Cuthrell

SAMPLING STATION NO. IH-3
SAMPLING LOCATION Composite of Several (4) Locations on site from top of dump

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ ___ HR. COMP. AT ___ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ___
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ___ EQUIP ___
COMPUTED FROM ___

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0103				BACTERIAL	0
DATE		10/20/80				BOD, COD, TOC	1
TIME		1130–1145				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, O&G, PEST	5
TOT. Cl2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		Selectee					9
SAMPLED BY (Sig)		SBH, [illegible]					A
SEALED BY (Sig)		SBH					B
DATE AND TIME		10/20/80 1200				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs   [2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
Bob Quinn	10/20/80	13:30	2		

REMARKS AND SKETCHES

1- "lower pile" - 1130
2- "upper pile" - 1140
3- " " 1142
4- " " 1145
1- 1qt glass - organic (ext P, vol R)
1- 1pt plastic - metals P (dupl. metals collected for IH)

U.S. ENVI..ONMENTAL PROTECTION D 0212
SURVEILLANCE AND ANALYSIS D

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis TN
CONTACT Gene Cuthrell

SAMPLING STATION NO. IH-6
SAMPLING LOCATION Effluent ditch Culvert @ field road ≈ 100 ft below discharge (NPDES) pipe

SAMPLE AND WASTE FLOW INFORMATION

WATER

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ ______ ☐ ______ HR. COMP. AT ______ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ______
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ______ EQUIP ______
COMPUTED FROM ______

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0188				BACTERIAL	0
DATE		10/20/80				BOD, COD, TOC	1
TIME		1420				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C		25.0				N, P	4
pH		6.4				ORG, O&G, PEST	5
TOT. Cl_2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		see below					9
SAMPLED BY (Sig)		BH Cuthrell					A
SEALED BY (Sig)		BH					B
DATE AND TIME		10/20/80 1520				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs
[2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
B. H. Cuthrell	10/20/80	1530	5		

REMARKS AND SKETCHES

D-0212

- 1 - 1 gal glass - organics
- 1 - 1 pt glass - metals
- 1 - VIAL - VOA
- 1 - ½ gal plastic - CN
- 1 - TOC

- metals dupl. collected for I H

U.S. ENV_ONMENTAL PROTECTION `ENCY

SURVEILLANCE AND ANALYSIS DIVISION

REGION IV

ATHENS, GEORGIA

DISCHARGER International Harvester	SAMPLING STATION NO. IH-7
ADDRESS Memphis, TN	SAMPLING LOCATION Effluent ditch @ culvert @ field ~100 ft below NPDES discharge pipe
CONTACT Gene Cuthell	

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☒ SEDIMENT ☐ ___ HR. COMP. AT ___ MIN. INTERVALS ☐ FLOW PRO.

SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ___ EQUIP ___

COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0157				BACTERIAL	0
DATE	/	10/20/80				BOD, COD, TOC	1
TIME	/	1425				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, O&G, PEST	5
TOT. Cl_2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		see below					9
SAMPLED BY (Sig)		JSH, CA, TLL					A
SEALED BY (Sig)		CDH/CA					B
DATE AND TIME		10/20/80 1500				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs [2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
B.E. Brown	10/20/80	15:30	2		

REMARKS AND SKETCHES

1 - 1 qt glass - organics - ext. P, VOA P

1 - 1 pt plastic - metals P (dupl. metals collected for IH)

* G P O 1980 - 640 - 198 / 1698, REGION NO. 4

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ATHENS, GEORGIA 30613

DATE: MAY 05 1981

SUBJECT: Supplemental Report -- Hazardous Waste Site Investigation -- International Harvester Company -- Memphis, Tennessee

FROM: Director, Surveillance and Analysis Division

TO: Howard Zeller, Acting Director
Enforcement Division

Attached is a copy of the subject report. A copy of this report should be sent to:

Mr. Gene Cutrell, Plant Engineer
International Harvester
3003 Harvester Lane
Memphis, Tennessee 38127

Billy H. Adams/for
James H. Finger

Attachment

cc: Wilburn
Scarbrough/Mathis
Newton/Turnipseed
Adams
Carroll/Bennett
Carter/Lair
Hall/Till

EPA/Region IV
Atlanta, GA

EPA Form 1320-6 (Rev. 3-76)

SUPPLEMENTAL REPORT
HAZARDOUS WASTE SITE INVESTIGATION
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE
APRIL 29, 1981

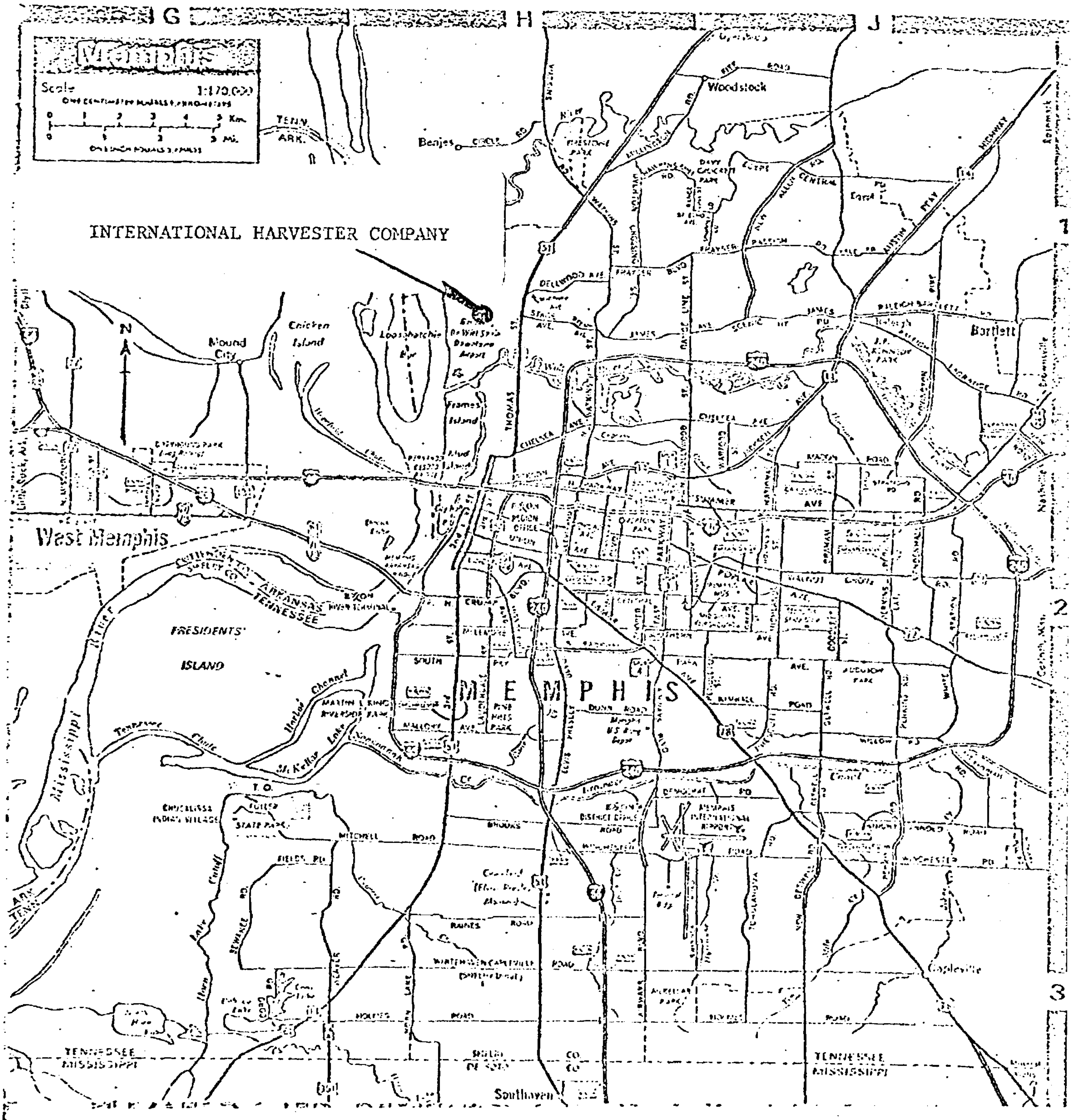
A hazardous waste site investigation report for International Harvester Company was issed April 7, 1981, by the U. S. Environmental Protection Agency, Surveillance and Analysis Division (SAD). At the time the report was issued, cyanide data were not available for the soil and sediment samples collected at the International Harvester Company. Cyanide analyses were reported on April 20, 1981, by the Laboratory Services Branch. These data are included in Table 1; general site location and sampling locations are included in Figures 1 and 2.

The cyanide concentration in sediment sample IH-3 (0.68 mg/kg) collected at the southern portion of the landfill appears to be higher than the concentrations in the other soil and sediment samples. The sediment sample (IH-7) taken from the drainage ditch that carries runoff to the Mississippi River contained a concentration of 0.27 mg/kg. The water sample (IH-6) contained a trace concentration (<.002 mg/l) but was too low to be quantified (see April 7, 1981 report).

TABLE 1
CYANIDE CONCENTRATIONS IN SOIL AND SEDIMENT SAMPLES
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

Sample Number	Location	Cyanide Concentration mg/kg (dry weight)
IH-2	Depositional area below the southern most part of landfill	0.68
IH-3	Depositional area below landfill in drainage ditch on western side of landfill	0.25
IH-4	Area below landfill on northern part of dump	0.37
IH-5	Composite sample collected on top of landfill	0.21
IH-7	Effluent and drainage ditch at culvert and field road	0.27

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE



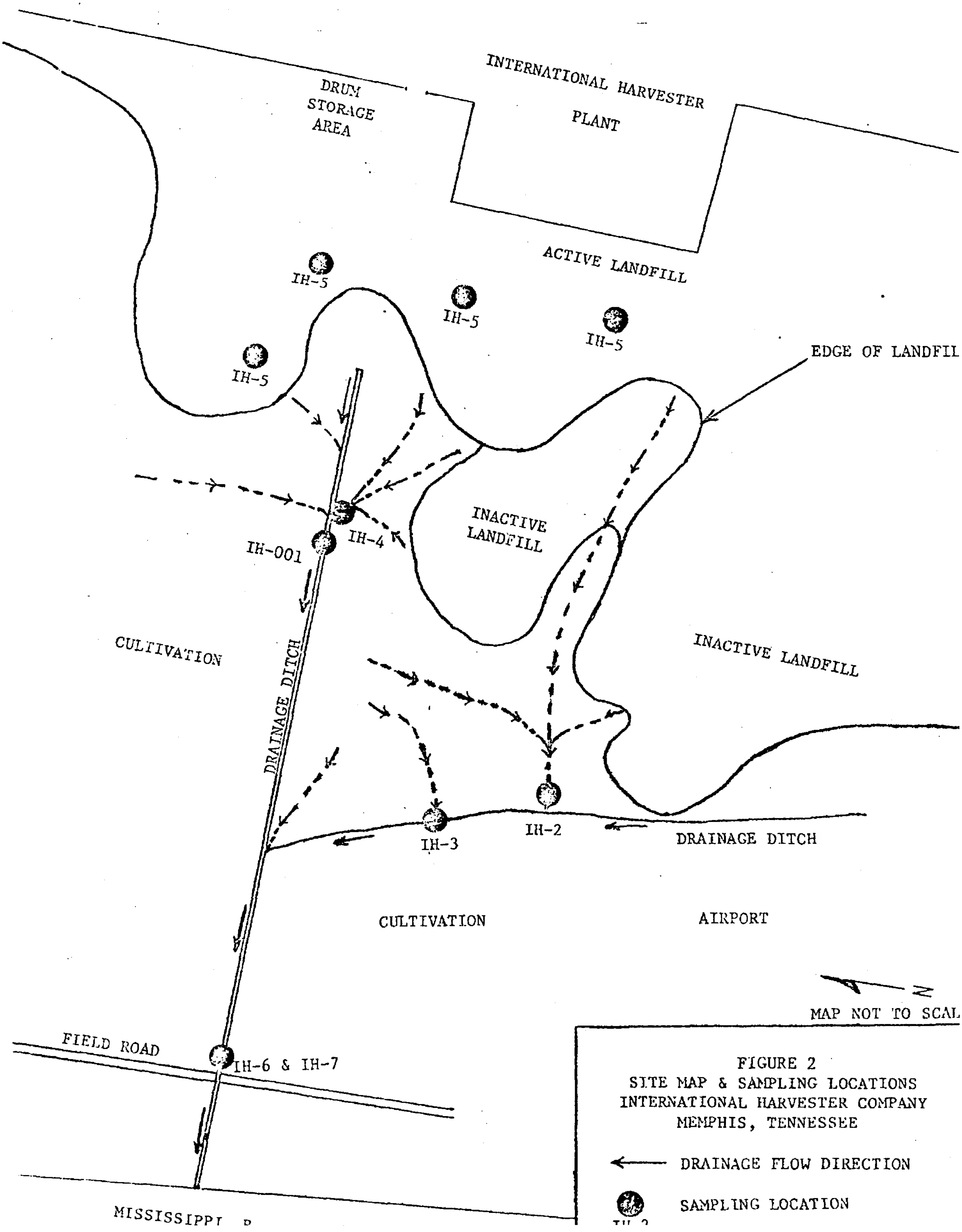


FIGURE 2
SITE MAP & SAMPLING LOCATIONS
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ATHENS, GEORGIA 30613

DATE: MAY 05 1981

SUBJECT: Supplemental Report -- Hazardous Waste Site Investigation -- International Harvester Company -- Memphis, Tennessee

FROM: Director, Surveillance and Analysis Division

TO: Howard Zeller, Acting Director
Enforcement Division

Attached is a copy of the subject report. A copy of this report should be sent to:

Mr. Gene Cutrell, Plant Engineer
International Harvester
3003 Harvester Lane
Memphis, Tennessee 38127

Billy H. Adams/for
James H. Finger

Attachment

cc: Wilburn
Scarbrough/Mathis
Newton/Turnipseed
Adams
Carroll/Bennett
Carter/Lair
Hall/Till

Compliance Branch

EPA Form 1320-6 (Rev. 3-76)

SUPPLEMENTAL REPORT
HAZARDOUS WASTE SITE INVESTIGATION
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE
APRIL 29, 1981

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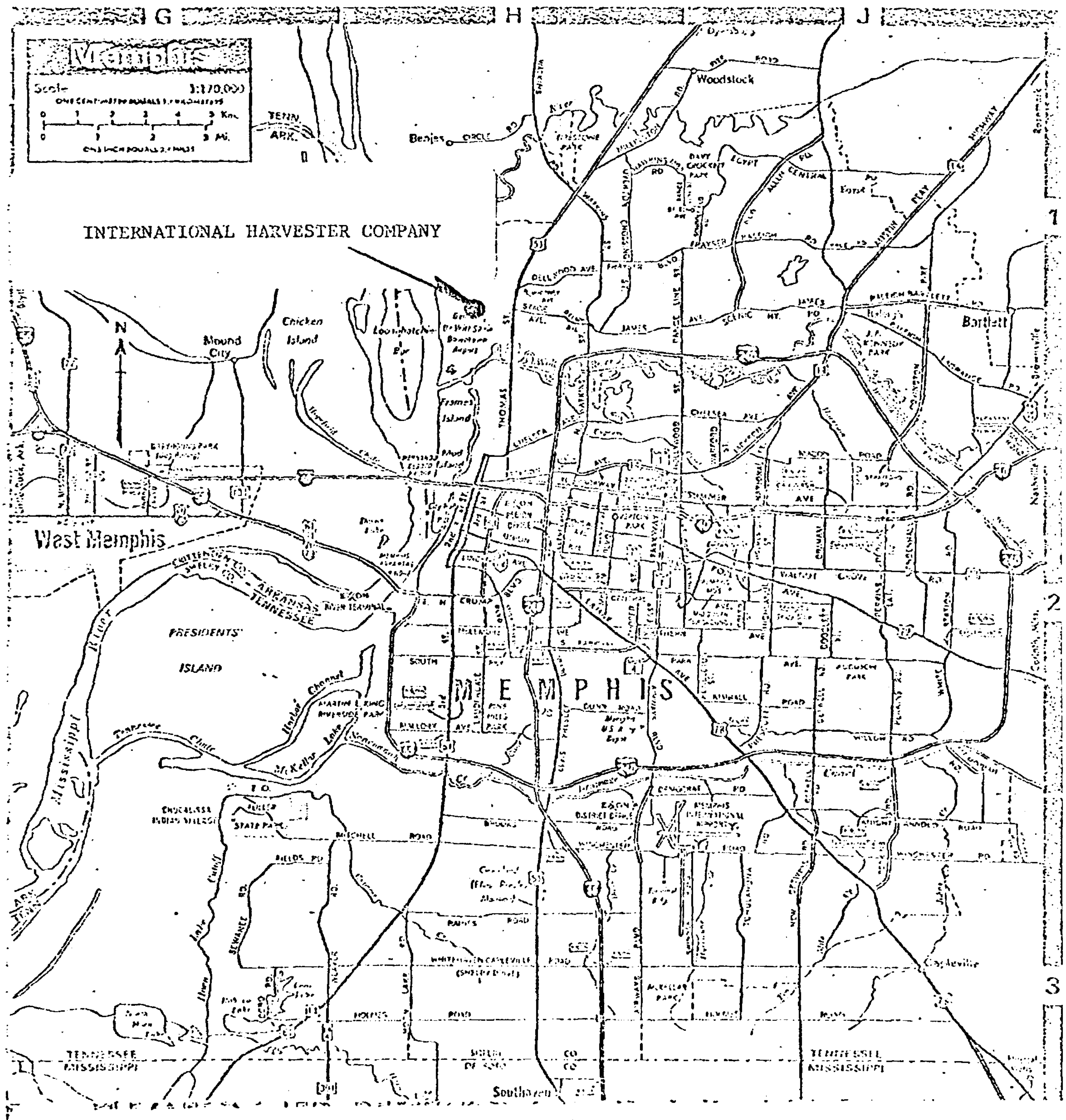
TABLE 1
CYANIDE CONCENTRATIONS IN SOIL AND SEDIMENT SAMPLES
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

Sample Number	Location	Cyanide Concentration mg/kg (dry weight)
IH-2	Depositional area below the southern most part of landfill	0.68
IH-3	Depositional area below landfill in drainage ditch on western side of landfill	0.25
IH-4	Area below landfill on northern part of dump	0.37
IH-5	Composite sample collected on top of landfill	0.21
IH-7	Effluent and drainage ditch at culvert and field road	0.27

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE



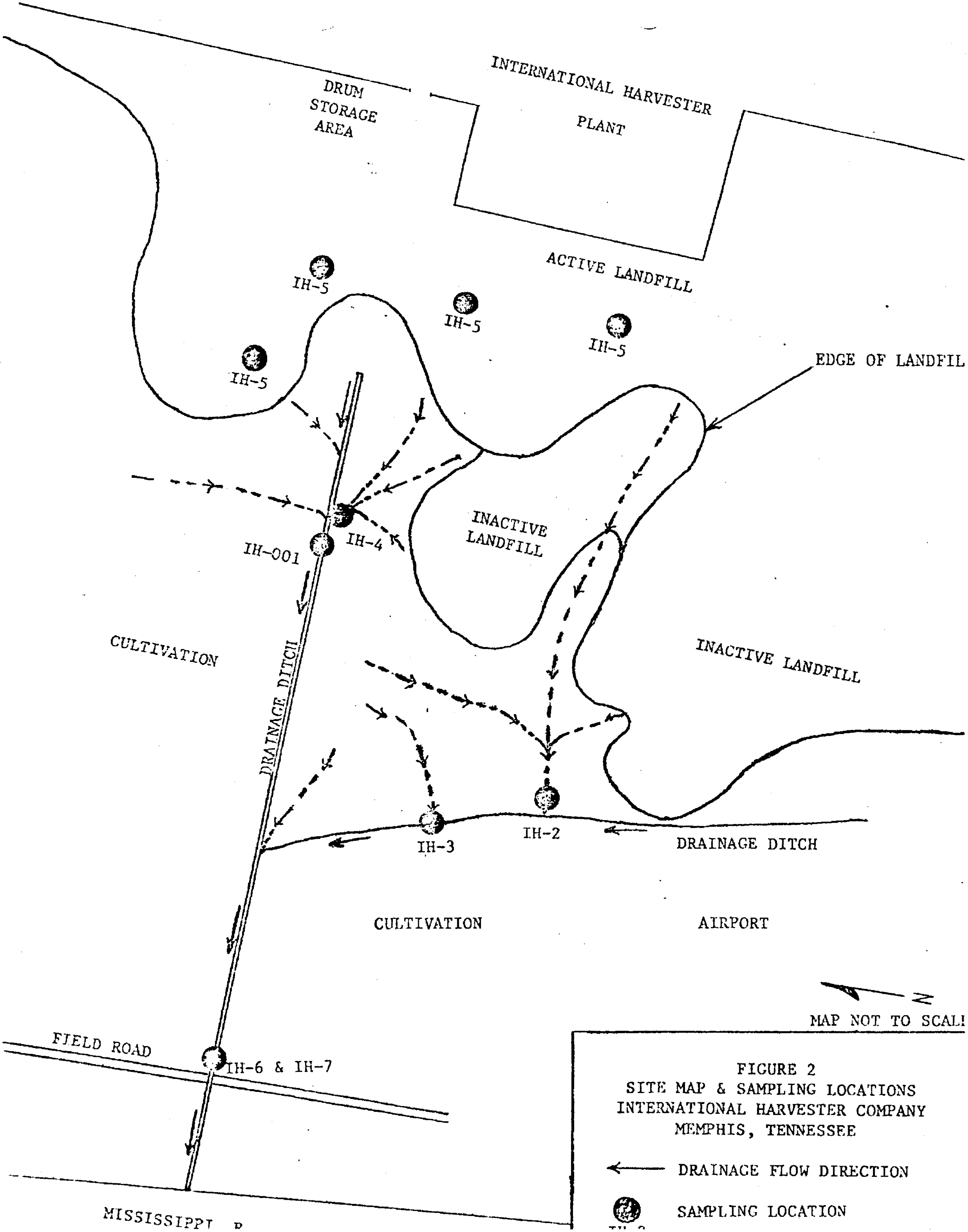


FIGURE 2
SITE MAP & SAMPLING LOCATIONS
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

ATHENS, GEORGIA 30613

DATE: AUG 27 1981

SUBJECT: Drums in Wooded Area Near International Harvester Company, Memphis, Tennessee

FROM: Environmental Engineer
Water Surveillance Branch

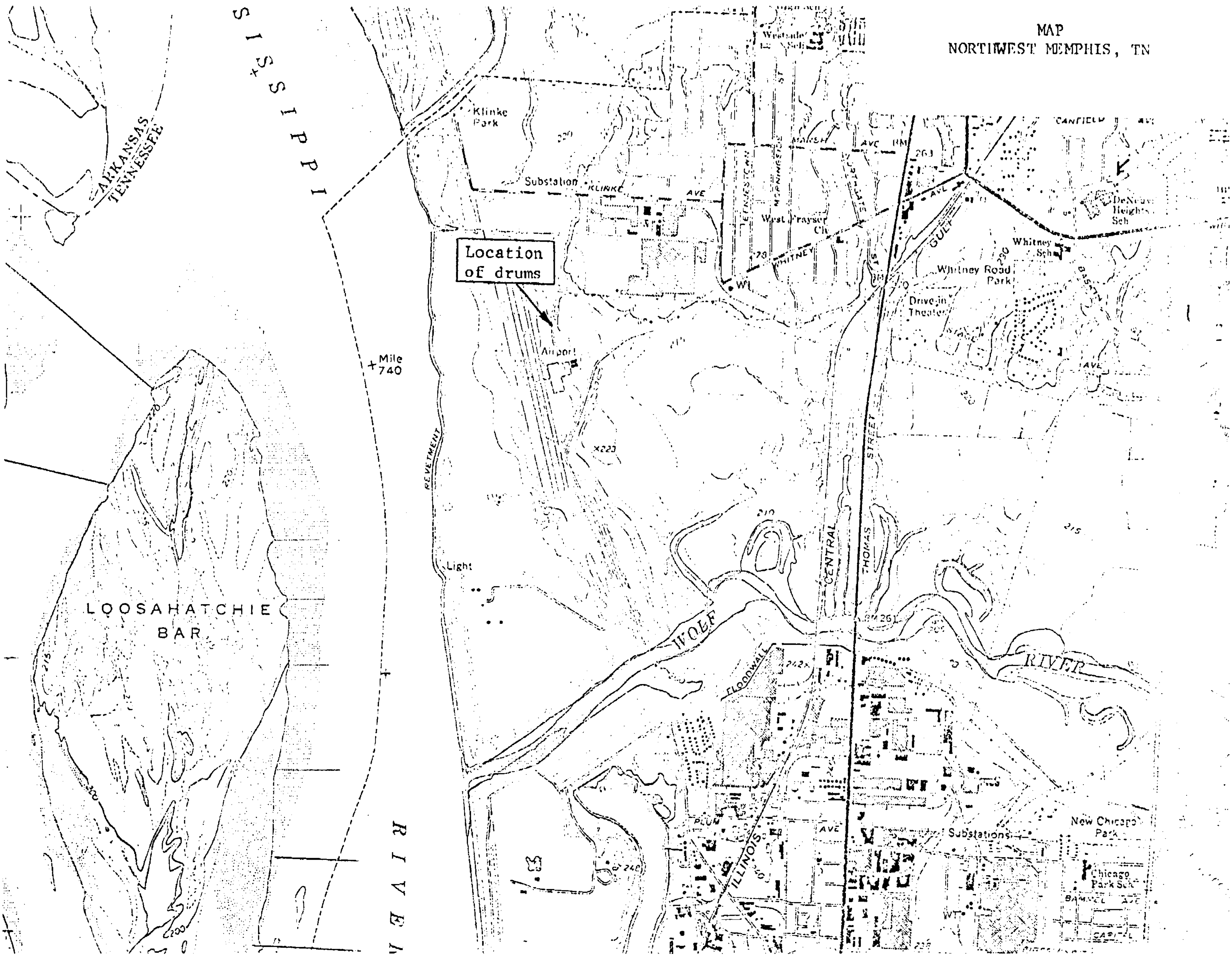
TO: Jim Wilburn, Chief
Compliance Branch

On April 6, 1981 while conducting a hazardous waste site field investigation (HWSI) in the Wolf River/2nd Street area of Memphis, Tennessee, Messrs. R. J. Bruner III, US-EPA/SAD and Neil Strickland, Ecology and Environment, Inc. were contacted by Mr. George Perkins. Mr. Perkins owned several tracts of land involved in the Wolf River/2nd Street area HWSI, and he requested that the investigators accompany him on a tour of the area so that he could point out the boundaries of his property. During the tour of his property, Mr. Perkins indicated that several drums were located in a small wooded area between the southwest corner of International Harvster Company and the DeWitt Spain Airport (see attached map). Enlargements of Enviropod photographs of the area were obtained from EPIC on August 24, 1981. These photographs (copies attached) confirm the location of approximately 50 drums in the wooded area. International Harvester Company should be contacted to determine what information the company has regarding the drums.

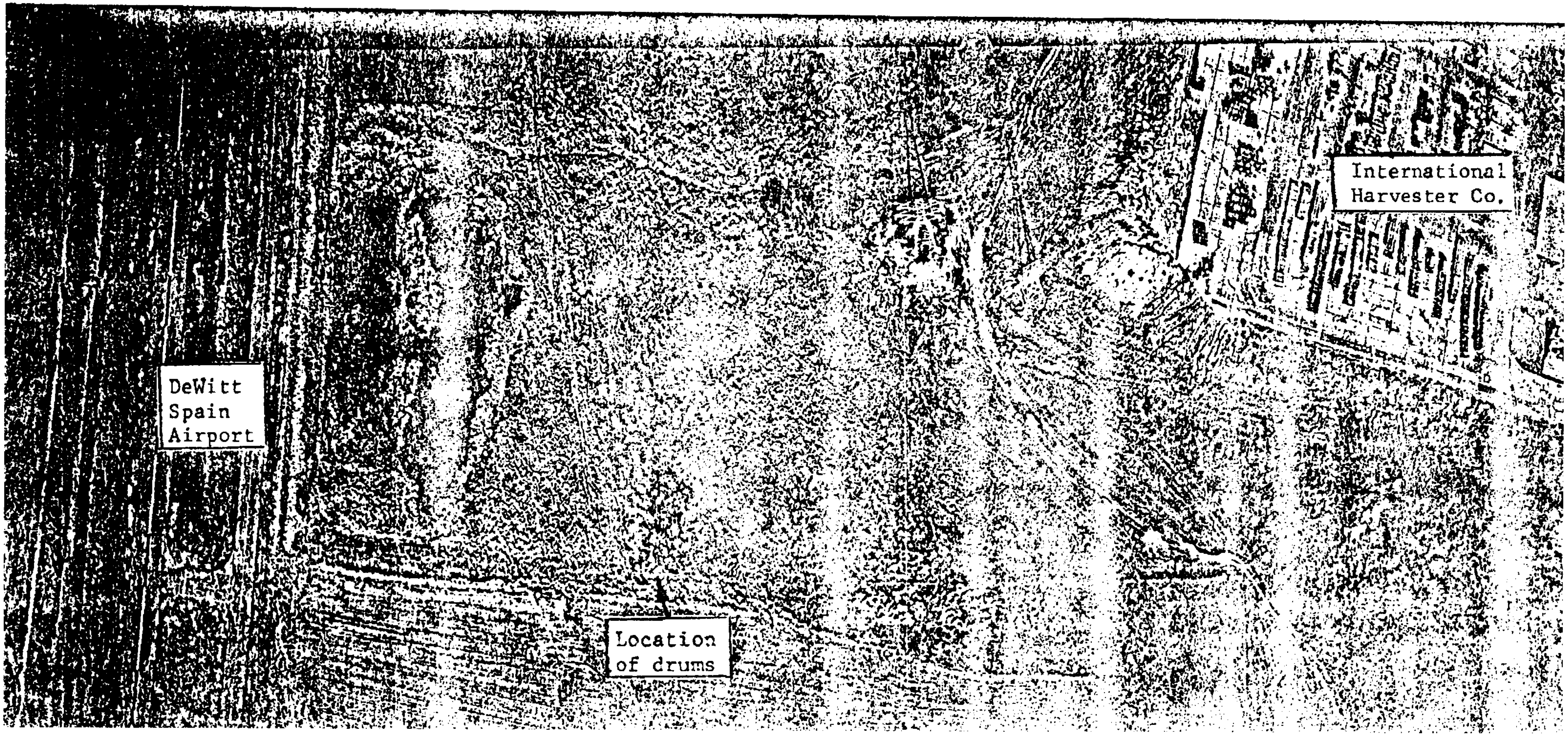
R. J. Bruner III, P.E.

cc: Wallace/Green
Newton/Turnipseed
✓Smith/Stonebraker/Mathis
Finger/Adams
Carter/Lair/Hill

MAP
NORTHWEST MEMPHIS, TN



Enviropod Aerial Photograph
2X Enlargement - Frame No. 153
Mission Flown Over Memphis, TN
December 3-4, 1980



HAZARDOUS WASTE SITE INVESTIGATION
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE
MARCH, 1981

INTRODUCTION

A hazardous waste site investigation was conducted at the International Harvester Company, Memphis, TN, during October 20-21, 1980 by J. S. Hall and Charles A. Till of the US Environmental Protection Agency (US-EPA), Region IV, Surveillance and Analysis Division (SAD). This investigation was initiated following a preliminary inspection by personnel of the US-EPA, Region IV, Enforcement Division in May 1980 (1). During the May 1980 inspection, US-EPA, investigators observed wood, pallets, crates, metal, paper, trash, glass, and drums in a landfill adjacent to the plant. The drums in the landfill were alledged to be empty (with the exception of some yellow drums filled with trash), and could not be sold or reconditioned. These drums were not accessible, so their contents or lack thereof were not verified by the US-EPA. The drums that were not sold or reconditioned were supposed to be crushed. There were also approximately 1000 empty drums stacked along the northeastern side of the landfill near the back entrance gate of the plant. The original contents of these drums were reported to be oil, paint, varnish, sealing compound, caustics, and hydrochloric acid.

STUDY AREA

The International Harvester Plant is located at 3003 Harvester Lane on the northwestern side of Memphis (see figure 1). The plant manufactures farm equipment. The manufacturing processes include casting, shearing, machining, welding, assembly, washing, plating, and painting. In addition to manufacturing complete pieces of equipment, the plant also manufactures parts to be shipped to other International Harvester Plants.

The subject landfill is located to the west of the plant. The landfill and adjacent area are situated on the Mississippi River floodplain. All runoff from the landfill drains toward the Mississippi River via a large drainage ditch. The soils around the landfill are floodplain alluvium that consist of materials formed from silts and clays washed from the adjacent uplands, and from silts, clays, sands and gravels deposited by the Mississippi River. The area immediately downgradient from the landfill is presently being farmed. The topography of the area consists of gently sloping uplands to nearly flat to flat bottom lands. (See figure 2 for site map)

During this investigation, four sediment, one soil, and two water samples were collected. Three sediment samples (IH-2, IH-3, IH-4) were collected in depositional areas downgradient from the landfill. A composite soil sample (IH-5) was collected from random locations on top of the landfill. The two water samples IH-6 and IH-001, and another sediment sample IH-7 were collected in the drainage ditch that conveys wastewater from the plant and surface runoff from the landfill to the Mississippi River (see figure 2 for sampling locations). All sampling points were located on International Harvester Company property.

DISCUSSIONS AND RESULTS

The soil and sediment samples were analyzed for organic compounds and metals. Water sample IH-6 was analyzed for organic compounds, metals, and cyanide. Water sample IH-001 was collected for an NPDES inspection so it was analyzed only for metals and other permitted parameters. Results of the NPDES investigation were forwarded January 29, 1981, and are not discussed in this report.

Sampling station locations are included in Table 1. All data included in tables 2 and 3 include only metals and organic compounds that were positively identified and quantified by laboratory analyses. Several organic compounds were tentively identified and concentrations were estimated; also, some trace concentrations (below the minimum detection level (MDL) of organic compounds and metals were detected but were too low to be quantified. These data, along with all of the analytical results, are included with the analytical data sheets in Attachment 1. Attachment 2 contains all of the field data record sheets.

Extractable and Purgeable Organic Compounds

3,4-benzofluoranthene and/or 11,12-benzofluoranthene was detected at a concentration of 1,500 ug/kg in the sediment sample (IH-3) collected in the small drainage ditch on the western side of the landfill. This sample would have been affected by runoff from most of the landfill area except for the northwest portion. Trace concentrations of eight other extractable organic compounds were detected, but were too low to be quantified (<1,000 ug/kg), including: naphthalene, phenanthrene and/or anthracene, fluoranthene, pyrene, chrysene and/or 1,2-benzanthracene, 3,4-benzopyrene, 1,12-benzoperylene, and phenol (<2,200 ug/kg). Also, 13 other extractable organic compounds were tentatively identified in this sample with estimated concentrations or concentrations too low to be quantified. (See Attachment 1).

Sediment sample IH-2, collected in a depositional area collected at the southern part of the site, contained trace concentrations of nine extractable organic compounds but were too low to be quantified (<1,000 ug/ kg). These were: naphthalene, phenanthrene and/or anthracene, fluoranthene, pyrene, 1,2-benzanthracene, 3,4-benzofluoranthene and/or 11,12-benzofluoranthene , 3,4-benzopyrene, 1,12-benzoperylene, and phenol (<500 ug/kg). Ten other extractable organic compounds were tentatively identified with estimated concentrations or concentrations too low to be quantified.

Sediment sample IH-4, collected in a depositional area of the northern part of the site, contained a trace concentration of phenol (<1,000 ug/kg). There were also four other extractable organic compounds tentatively identified with estimated concentrations or concentrations too low to be quantified.

Soil sample IH-5 collected on the landfill, contained trace concentrations of fluoranthene (<15,000 ug/kg) and pyrene (<15,000 ug/kg). Also, one other extractable organic compound was tentatively identified in IH-5, but the concentration was too low to be quantified.

Sediment sample IH-7, collected from the large drainage ditch below the site, contained seven extractable organic compounds that were tentatively identified with estimated concentrations, or concentrations too low to be quantified.

The water sample IH-6, collected from the large drainage ditch below the site, contained no detectable extractable organic compounds.

The only purgeable organic compound detected in any of the soil and sediment or water samples collected during this investigation was dichlorodifluoromethane at a trace concentration (<5 ug/kg) in soil sample IH-4.

Chlorinated Organic Compounds

Polychlorinated biphenyls (PCB's) were detected in all of the soil and sediment samples. The concentrations and compounds were as follows: (IH-2), PCB (Aroclor 1248, 18,000 ug/kg); (IH-3), PCB (Aroclor 1248, 5,500 ug/kg); (IH-4), PCB (Aroclor 1248, 8,900 ug/kg); (IH-5), PCB (Aroclor 1254, 3,800 ug/kg); and (IH-7); PCB (Aroclor 1254, 180 ug/kg). These data indicate that PCB concentrations were higher in the landfill area than in the drainage ditch sediments downgradient from the landfill (see figure 2 and table 2). PCB's have been used in numerous commercial applications such as plasticizers, heat transfer fluids, hydraulic fluids, fluids in vacuum pumps and compressors, lubricants, and wax extenders. (2)

Metals

Iron was detected in all of the soil and sediment samples ranging in concentration from 21,360 ug/kg to 41,000 ug/kg. Sediment sample IH-3 contained lead at a concentration of 112 ug/kg, and zinc at a concentration of 147 ug/kg. Sediment sample IH-4 contained chromium, 141 ug/kg; lead, 468 ug/kg, and zinc, 175 ug/kg. Sediment sample IH-7 contained chromium, 278 ug/kg; lead 210 ug/kg; and zinc, 174 ug/kg. Soil sample IH-5 contained chromium at a concentration of 104 ug/kg. Chromium was detected in water sample IH-6 at a concentration of 104 ug/L. None of the other metals detected in the soil, sediment or water samples displayed high concentrations (3) (See table 2 for concentrations).

METHODOLOGY

All sampling and preservation methods used during this investigation were in accordance with the Water Surveillance Branch Standard Operating Procedures and Quality Assurance Manual, August 29, 1980 (4). Chain-of-custody was maintained from time of collection until samples were relinquished to Laboratory Services Branch (LSB) personnel at the North Treatment Plant in Memphis.

Analyses were conducted by the US-EPA, SAD, Laboratory Services Branch (LSB) and Mead Technology (contract laboratory). The soil, sediment and water samples were analyzed for organic compounds and metals by the (LSB). Water sample IH-6 was analyzed by Mead Technology for organic compounds. The (LSB) analyzed water sample IH-6 for metals and cyanide. Water sample IH-001 was analyzed by the (LSB) for NPDES parameters.

REFERENCES

1. "Report - Hazardous Waste Site Investigation - Memphis, Tennessee - First Phase", US Environmental Protection Agency, Region IV, Enforcement Division; June 1980.

2. Ambient Water Quality Criteria for Polychlorinated Biphenyls United States Environmental Protection Agency, EPA-440/5-80-068, 1980.

3. Hazardous Waste Site Investigation, Frayser Pond Site, Memphis, TN. US Environmental Protection Agency, Region IV, Surveillance and Analysis Division, September 17, 1980.

4. Water Surveillance Branch Standard Operating Procedures and Quality Assurance Manual. (Draft); US Environmental Protection Agency Region IV, Surveillance and Analysis Division, August 29, 1980.

Table 1
Sampling Locations
International Harvester Company
Memphis, Tennessee
March, 1981

Field Identification	SAD No.	Date	Time	Description	Type Sample
IH-2	81C 0103	10/20	1045	Depositional area below the southern most part of landfill.	Sediment
IH-3	81C 0104	10/20	1100	Depositional area below landfill in drainage ditch on western side of site	Sediment
IH-4	81C 0106	10/20	1120	Area below landfill on northern most part of dump.	Sediment
IH-5	81C 0105	10/20	1130 1145	Composite sample from several locations on top of landfill.	Soil
IH-6	81C 0108	10/20	1420	Effluent ditch at culvert and field rd. Approx. 1000 ft. below NPDES discharge pipe.	Water
IH-7	81C 0107	10/20	1425	Effluent ditch at culvert and field rd. Approx. 1000 ft. below NPDES discharge pipe.	Sediment
IH-001	81C 0150	10/21	0935	NPDES outfall in ditch discharging from the plant.	Water

Table 2
Analytical Results
Soil Samples
International Harvester Company
Memphis, Tennessee
March, 1981

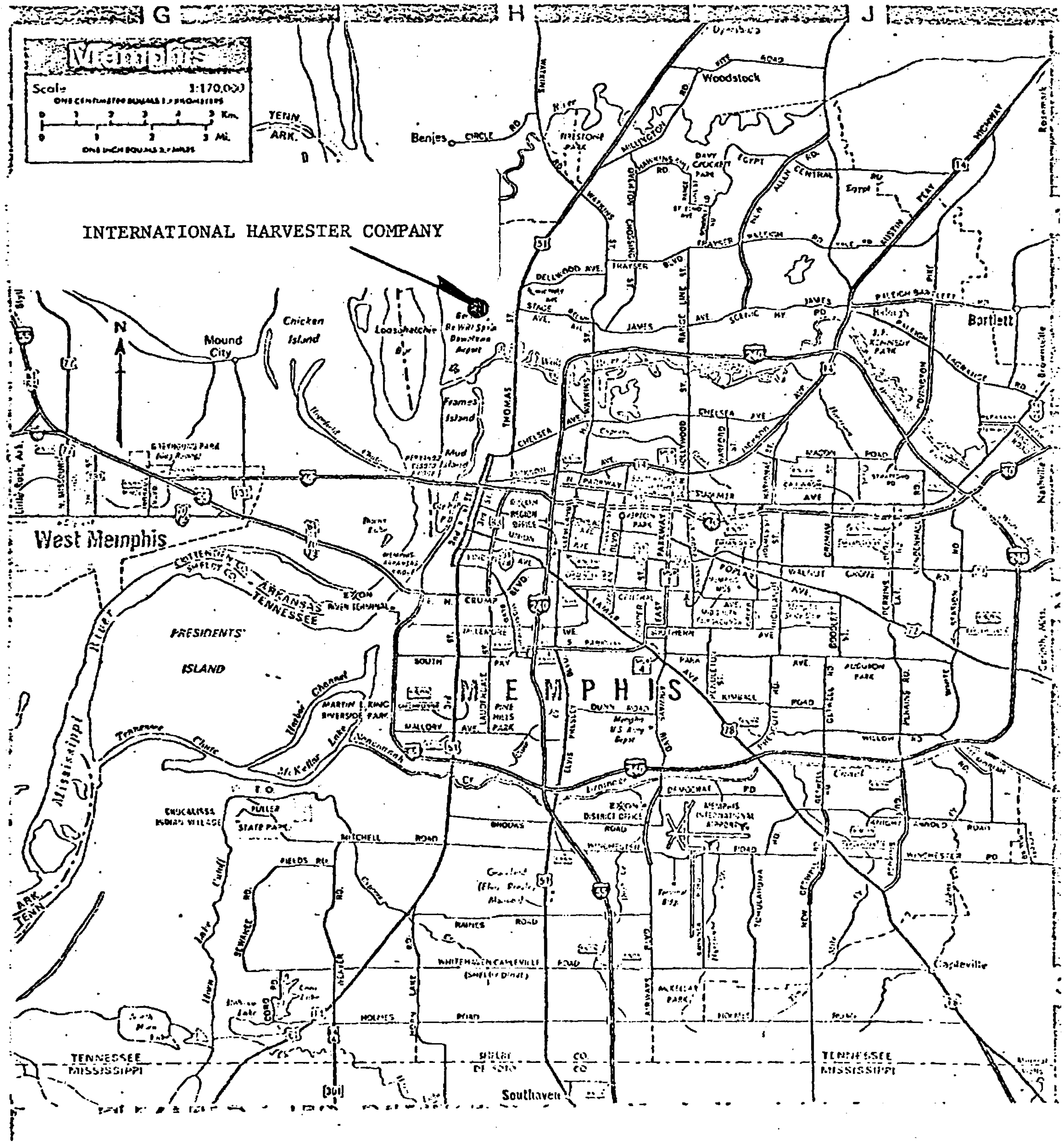
Parameter	Sample Locations				
	IH-2	IH-3	IH-4	IH-5	IH-7
3,4 - benzofluoranthene and/or 11,12 - benzofluoranthene (ug/kg)	ND	1500	ND	ND	ND
Barium (mg/kg)	111	199	316	68	221
Cadmium (mg/kg)	ND	ND	ND	ND	4
Chromium (mg/kg)	30	44	141	104	278
Copper (mg/kg)	26	40	74	50	37
Nickel (mg/kg)	18	31	35	29	33
Lead (mg/kg)	70	112	468	57	210
Strontium (mg/kg)	37	48	92	46	41
Titanium (mg/kg)	275	533	320	112	224
Vanadium (mg/kg)	19	49	27	17	55
Yttrium (mg/kg)	5	11	8	4	14
Zinc (mg/kg)	83	147	175	54	174
Zirconium (mg/kg)	4	ND	5	ND	ND
Mercury (mg/kg)	ND	ND	ND	ND	0.1
Calcium (mg/kg)	17,638	13,170	19,300	6,591	6,050
Magnesium (mg/kg)	5,176	7,497	6,800	2,977	5,350
Aluminum (mg/kg)	7,282	20,985	15,900	6,200	23,750
Iron (mg/kg)	21,360	30,990	41,100	29,680	31,050
Manganese (mg/kg)	502	786	665	426	875
Sodium (mg/kg)	ND	ND	545	390	ND
PCB, (Aroclor 1248) (ug/kg)	18,000	5,500	8,900	ND	ND
PCB, (Aroclor 1254) (ug/kg)	ND	ND	ND	3,800	180

Note: ND - Indicates material was analyzed for but not detected at or above the minimum detection limit.

Table 3
Analytical Results
Water Sample (IH-6) and NPDES Discharge Sample (IH-001)
International Harvester Company
Memphis, Tennessee
March, 1981

Parameter	IH-6	IH-001
	(ug/L)	(ug/L)
Barium	41	38
Chromium	104	58
Copper	14	11
Molybdenum	215	68
Strontium	44	38
Aluminum	300	154
Calcium	13	13
Magnesium	5.9	6
Iron	1.0	0.6
Sodium	17.0	12

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE



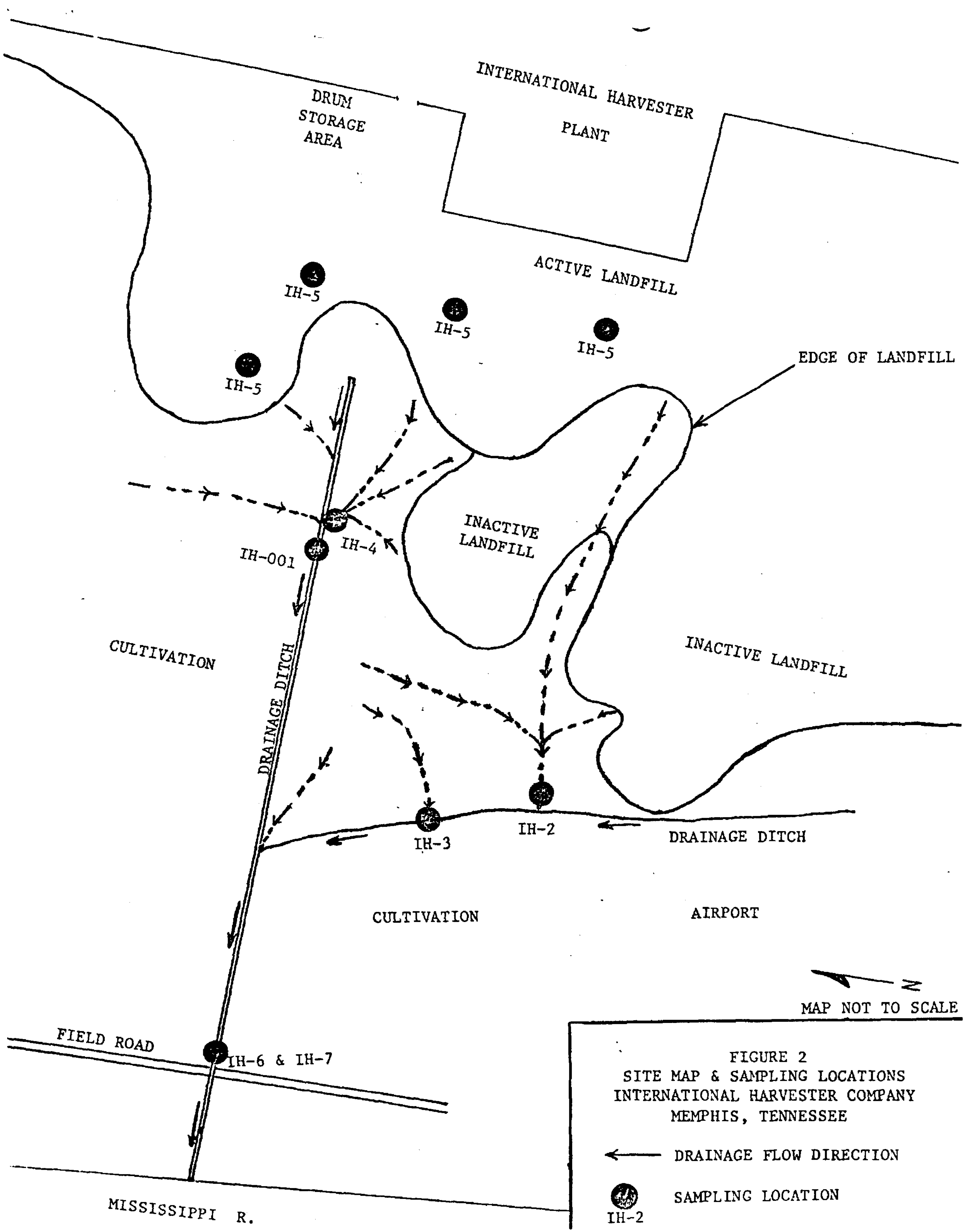


FIGURE 2
SITE MAP & SAMPLING LOCATIONS
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

ATTACHMENT 1

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN
CHEMIST E. W. Loy, Jr.
REC'D. 10-20-80 COMPL'D. 1-26-81

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0103		
SOURCE & STATION		IH-2 Depositional area below So. most part of dump.		
DATE/TIME		10-20-80 @ 1045		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	1000U		
26. 1,3-dichlorobenzene	34569	1000U		
27. 1,4-dichlorobenzene	34574	1000U		
18. bis(2-chloroethyl) ether	34276	1000U		
12. hexachloroethane	34399	1000U		
42. bis(2-chloroisopropyl) ether	34286	1000U		
63. N-nitrosodi-n-propylamine	34431	2000U		
56. nitrobenzene	34450	1000U		
52. hexachlorobutadiene	39705	1000U		
8. 1,2,4-trichlorobenzene	34554	1000U		
55. naphthalene	34445	1000K		
43. bis(2-chloroethoxy) methane	34281	1000U		
54. isophorone	34411	2000U		
53. hexachlorocyclopentadiene	34389	1000U		
20. 2-chloronaphthalene	34584	1000U		
77. acenaphthylene	34203	1000U		
1. acenaphthene	34208	1000U		
71. dimethyl phthalate	34344	1000U		
35. 2,4-dinitrotoluene	34614	1000U		
36. 2,6-dinitrotoluene	34629	1000U		
40. 4-chlorophenyl phenyl ether	34644	1000U		
80. fluorene	34384	1000U		
70. diethyl phthalate	34339	1000U		
37. 1,2-diphenylhydrazine 2/	34349	1000U		
62. N-nitrosodiphenylamine 3/	34436	1000U		
9. hexachlorobenzene	39701	1000U		
41. 4-bromophenyl phenyl ether	34639	1000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	1000K		
68. di-n-butyl phthalate	39112	1000U		
39. fluoranthene	34379	1000K		
84. pyrene	34472	1000K		
67. butyl benzyl phthalate	34295	1000U		
5. benzidine	39121	2000U		
66. bis(2-ethylhexyl) phthalate	39102	1000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	1000K		
28. 3,3'-dichlorobenzidine	34634	1000U		
69. di-n-octyl phthalate	34599	1000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	1000K		
73. 3,4-benzopyrene	34250	1000K		
83. indeno (1,2,3-cd) pyrene	34406	1000U		
82. 1,2,5,6-dibenzanthracene	34559	1000U		
79. 1,12-benzoperylene	34524	1000K		
24. 2-chlorophenol	34589	500U		
57. 2-nitrophenol	34594	500U		
65a. phenol (GC/MS)	34695	500K		
34. 2,4-dimethylphenol	34609	500U		
31. 2,4-dichlorophenol	34604	500U		
21. 2,4,6-trichlorophenol	34624	500U		
22. parachlorometa cresol	34455	500U		
59. 2,4-dinitrophenol	34619	4000U		
60. 4,6-dinitro-o-cresol	34660	500U		
64. pentachlorophenol	39061	500U		
58. 4-nitrophenol	34649	1000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.
4/
5/ - Chrysene and/or 1,2-benzanthracene
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26-8

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0103		
SOURCE & STATION	IH-2 Depositional area below So. most part of dump.		
DATE/TIME	10-20-80 @ 1045		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
biphenyl 1/	1000K		
dichlorobenzophenone 1/	1000K		
hydroxybenzaldehyde 1/	500K		
C_3 phenol 1/	500K		
C_2 phenol 1/	500K		
tetradecanoic acid, methyl ester 1/	500K		
isobenzofurandione 1/	500K		
pentadecanoic acid, methyl, methyl ester 1/	800J		
octadecenoic acid, methyl ester 1/	900J		
hexadecanoic acid 1/	2700J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 1000 ug/kg

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/- Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN CHEMIST E.W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26-81

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0104		
SOURCE & STATION		IH-3 Area below dump ditch on Western side of site.		
DATE/TIME		10-20-80 @ 1100		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	1000U		
26. 1,3-dichlorobenzene	34569	1000U		
27. 1,4-dichlorobenzene	34574	1000U		
18. bis(2-chloroethyl) ether	34276	1000U		
12. hexachloroethane	34399	1000U		
42. bis(2-chloroisopropyl) ether	34286	1000U		
63. N-nitrosodi-n-propylamine	34431	2000U		
56. nitrobenzene	34450	1000U		
52. hexachlorobutadiene	39705	1000U		
8. 1,2,4-trichlorobenzene	34554	1000U		
55. naphthalene	34445	1000K		
43. bis(2-chloroethoxy) methane	34281	1000U		
54. isophorone	34411	2000U		
53. hexachlorocyclopentadiene	34389	1000U		
20. 2-chloronaphthalene	34584	1000U		
77. acenaphthylene	34203	1000U		
1. acenaphthene	34208	1000U		
71. dimethyl phthalate	34344	1000U		
35. 2,4-dinitrotoluene	34614	1000U		
36. 2,6-dinitrotoluene	34629	1000U		
40. 4-chlorophenyl phenyl ether	34644	1000U		
80. fluorene	34384	1000U		
70. diethyl phthalate	34339	1000U		
37. 1,2-diphenylhydrazine 2/	34349	1000U		
62. N-nitrosodiphenylamine 3/	34436	1000U		
9. hexachlorobenzene	39701	1000U		
41. 4-bromophenyl phenyl ether	34639	1000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	1000K		
68. di-n-butyl phthalate	39112	1000U		
39. fluoranthene	34379	1000K		
84. pyrene	34472	1000K		
67. butyl benzyl phthalate	34295	1000U		
5. benzidine	39121	2000U		
66. bis(2-ethylhexyl) phthalate	39102	1000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	1000K		
28. 3,3'-dichlorobenzidine	34634	1000U		
69. di-n-octyl phthalate	34599	1000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	1500		
73. 3,4-benzopyrene	34250	1000K		
83. indeno (1,2,3-cd) pyrene	34406	1000U		
82. 1,2,5,6-dibenzanthracene	34559	1000U		
79. 1,12-benzoperylene	34524	1000K		
24. 2-chlorophenol	34589	2200U		
57. 2-nitrophenol	34594	2200U		
65a. phenol (GC/MS)	34695	2200K		
34. 2,4-dimethylphenol	34609	2200U		
31. 2,4-dichlorophenol	34604	2200U		
21. 2,4,6-trichlorophenol	34624	2200U		
22. parachlorometa cresol	34455	2200U		
59. 2,4-dinitrophenol	34619	11,000U		
60. 4,6-dinitro-o-cresol	34660	2200U		
64. pentachlorophenol	39061	2200U		
58. 4-nitrophenol	34649	4400U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.
4/ - Phenanthrene and/or anthracene.
5/ - Chrysene and/or 1,2-benzanthracene.
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

EPA, SAD, RGN. IV
Athens, GA 4/80

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

PROJECT International Harvester Memphis, TN CHEMIST E.W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-26-

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0104		
SOURCE & STATION	IH-3 Area below dump ditch on Western side of site.		
DATE/TIME	10-20-80 @ 1100		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentratio ug/kg
C_3 alkyl benzene 1/	1000K		
methyl naphthalene (2 isomers) 1/	1000K		
biphenyl 1/	1000K		
C_2 alkyl naphthalene (2 isomers) 1/	1000K		
methyl phenanthrene (2isomers) 1/	1000K		
C_3 alkyl phenol 1/	2200K		
tetradecanoic acid, methyl ester 1/	2200K		
tetradecanoic acid, methyl, methyl ester 1/	2200K		
isobenzofurandione 1/	2200K		
pentadecanoic acid, methyl, methyl ester 1/	5900J		
hexadecanoic acid, methyl, methyl ester 1/	2200K		
octadecenoic acid, methyl ester 1/	5000J		
hexadecanoic acid 1/	7100J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 2500 ug/kg

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/ - Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/80

PROJECT International Harvester Memphis, TN   CHEMIST E. W. Loy, Jr.   REC'D. 10-20-80   COMPL'D. 2-3-8

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0106		
SOURCE & STATION		IH-4 Area below dump on Northern most part of dump.		
DATE/TIME		10-20-80 @ 1120		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	40000U		
26. 1,3-dichlorobenzene	34569	40000U		
27. 1,4-dichlorobenzene	34574	40000U		
18. bis(2-chloroethyl) ether	34276	40000U		
12. hexachloroethane	34399	40000U		
42. bis(2-chloroisopropyl) ether	34286	40000U		
63. N-nitrosodi-n-propylamine	34431	80000U		
56. nitrobenzene	34450	40000U		
52. hexachlorobutadiene	39705	40000U		
8. 1,2,4-trichlorobenzene	34554	40000U		
55. naphthalene	34445	40000U		
43. bis(2-chloroethoxy) methane	34281	40000U		
54. isophorone	34411	80000U		
53. hexachlorocyclopentadiene	34389	40000U		
20. 2-chloronaphthalene	34586	40000U		
77. acenaphthylene	34203	40000U		
1. acenaphthene	34208	40000U		
71. dimethyl phthalate	34344	40000U		
35. 2,4-dinitrotoluene	34614	40000U		
36. 2,6-dinitrotoluene	34629	40000U		
40. 4-chlorophenyl phenyl ether	34644	40000U		
80. fluorene	34384	40000U		
70. diethyl phthalate	34339	40000U		
37. 1,2-diphenylhydrazine 2/	34349	40000U		
62. N-nitrosodiphenylamine 3/	34436	40000U		
9. hexachlorobenzene	39701	40000U		
41. 4-bromophenyl phenyl ether	34639	40000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	40000U		
68. di-n-butyl phthalate	39112	40000U		
39. fluoranthene	34379	40000U		
84. pyrene	34472	40000U		
67. butyl benzyl phthalate	34295	40000U		
5. benzidine	39121	80000U		
66. bis(2-ethylhexyl) phthalate	39102	40000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	40000U		
28. 3,3'-dichlorobenzidine	34634	40000U		
69. di-n-octyl phthalate	34599	40000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	40000U		
73. 3,4-benzopyrene	34250	40000U		
83. indeno (1,2,3-cd) pyrene	34406	40000U		
82. 1,2,5,6-dibenzanthracene	34559	40000U		
79. 1,12-benzoperylene	34524	40000U		
24. 2-chlorophenol	34589	7500U		
57. 2-nitrophenol	34594	7500U		
65a. phenol (GC/MS)	34695	7500K		
34. 2,4-dimethylphenol	34609	7500U		
31. 2,4-dichlorophenol	34604	7500U		
21. 2,4,6-trichlorophenol	34624	7500U		
22. parachlorometa cresol	34455	7500U		
59. 2,4-dinitrophenol	34619	60000U		
60. 4,6-dinitro-o-cresol	34660	7500U		
64. pentachlorophenol	39061	7500U		
58. 4-nitrophenol	34649	15000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.

5/ - Chrysene and/or 1,2-benzanthr[acene]
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D 2-3

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0106		
SOURCE & STATION	IH-4 Area below dump on Northern most part of dump.		
DATE/TIME	10-20-80 @ 1120		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentra ug/kg
1 phenol 1,2 butane diol 1/	7500K	7500K	760
decanoic acid, methyl ester 1/	7500K	7500K	7600
hexadecanoic acid, methyl ester 1/	9800J	12,000J	760
octadecanoic acid, methyl ester 1/	9800J	12,000J	760
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 40000 u

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit

1/ - Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RCM
Athens, GA

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0105		
SOURCE & STATION		IH-5 Composite of 4 sites from top of dump. 10-20-80 @ 1130		
DATE/TIME		10-20-80 @ 1145		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentr. ug/k
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	15000U		
26. 1,3-dichlorobenzene	34569	15000U		
27. 1,4-dichlorobenzene	34574	15000U		
18. bis(2-chloroethyl) ether	34276	15000U		
12. hexachloroethane	34399	15000U		
42. bis(2-chloroisopropyl) ether	34286	15000U		
63. N-nitrosodi-n-propylamine	34431	30000U		
56. nitrobenzene	34450	15000U		
52. hexachlorobutadiene	39705	15000U		
8. 1,2,4-trichlorobenzene	34554	15000U		
55. naphthalene	34445	15000U		
43. bis(2-chloroethoxy) methane	34281	15000U		
54. isophorone	34411	30000U		
53. hexachlorocyclopentadiene	34389	15000U		
20. 2-chloronaphthalene	34584	15000U		
77. acenaphthylene	34203	15000U		
1. acenaphthene	34205	15000U		
71. dimethyl phthalate	34344	15000U		
35. 2,4-dinitrotoluene	34614	15000U		
36. 2,6-dinitrotoluene	34629	15000U		
40. 4-chlorophenyl phenyl ether	34644	15000U		
80. fluorene	34384	15000U		
70. diethyl phthalate	34339	15000U		
37. 1,2-diphenylhydrazine 2/	34349	15000U		
62. N-nitrosodiphenylamine 3/	34436	15000U		
9. hexachlorobenzene	39701	15000U		
41. 4-bromophenyl phenyl ether	34639	15000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	15000U		
68. di-n-butyl phthalate	39112	15000U		
39. fluoranthene	34379	15000K		
84. pyrene	34472	15000K		
67. butyl benzyl phthalate	34295	15000U		
5. benzidine	39121	30000U		
66. bis(2-ethylhexyl) phthalate	39102	15000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	15000U		
28. 3,3'-dichlorobenzidine	34634	15000U		
69. di-n-octyl phthalate	34599	15000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	15000U		
73. 3,4-benzopyrene	34250	15000U		
83. indeno (1,2,3-cd) pyrene	34406	15000U		
82. 1,2,5,6-dibenzanthracene	34559	15000U		
79. 1,12-benzoperylene	34524	15000U		
24. 2-chlorophenol	34589	500U		
57. 2-nitrophenol	34594	500U		
65a. phenol (GC/MS)	34695	500U		
34. 2,4-dimethylphenol	34609	500U		
31. 2,4-dichlorophenol	34604	500U		
21. 2,4,6-trichlorophenol	34624	500U		
22. parachlorometa cresol	34455	500U		
59. 2,4-dinitrophenol	34619	4000U		
60. 4,6-dinitro-o-cresol	34660	500U		
64. pentachlorophenol	39061	500U		
58. 4-nitrophenol	34649	1000U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ -

5/ - Chrysene and/or 1,2-benza...
6/ - 3,4-benzofluoranthene and 11,12-benzofluoranthene.

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 4/8

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 1-2

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0105		
SOURCE & STATION	IH-5 Composite of 4 sites from top of dump. 10-20-80 @ 1130		
DATE/TIME	10-20-80 @ 1145		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentrati ug/kg
pentadecanoic acid, methyl, methyl ester 1/	500K		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 15,000 ug/

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/ - Tentative identification.

SEDIMENT
DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. I
Athens, GA 4/3

PROJECT Internation Harvester Memphis, TN   CHEMIST E. W. Loy, Jr.   REC'D. 10-20-80   COMPL'D. 2-17-

RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0107		
SOURCE & STATION		IH-7 Eff. ditch at Culvert at field Rd. below pipe		
DATE/TIME		10-20-80 @ 1426		
Compounds on NRDC List of Priority Pollutants		Concentration ug/kg	Concentration ug/kg	Concentration ug/kg
17. bis(chloromethyl) ether	34271	NA	NA	NA
61. N-nitrosodimethylamine	34441	NA	NA	NA
25. 1,2-dichlorobenzene	34539	5000U		
26. 1,3-dichlorobenzene	34569	5000U		
27. 1,4-dichlorobenzene	34574	5000U		
18. bis(2-chloroethyl) ether	34276	5000U		
12. hexachloroethane	34399	5000U		
42. bis(2-chloroisopropyl) ether	34286	5000U		
63. N-nitrosodi-n-propylamine	34431	10000U		
56. nitrobenzene	34450	5000U		
52. hexachlorobutadiene	39705	5000U		
8. 1,2,4-trichlorobenzene	34554	5000U		
55. naphthalene	34445	5000U		
43. bis(2-chloroethoxy) methane	34281	5000U		
54. isophorone	34411	10000U		
53. hexachlorocyclopentadiene	34389	5000U		
20. 2-chloronaphthalene	34584	5000U		
77. acenaphthylene	34203	5000U		
1. acenaphthene	34205	5000U		
71. dimethyl phthalate	34344	5000U		
35. 2,4-dinitrotoluene	34614	5000U		
36. 2,6-dinitrotoluene	34629	5000U		
40. 4-chlorophenyl phenyl ether	34644	5000U		
80. fluorene	34384	5000U		
70. diethyl phthalate	34339	5000U		
37. 1,2-diphenylhydrazine 2/	34349	5000U		
62. N-nitrosodiphenylamine 3/	34436	5000U		
9. hexachlorobenzene	39701	5000U		
41. 4-bromophenyl phenyl ether	34639	5000U		
81. phenanthrene 4/	34464			
78. anthracene 4/	34223	5000U		
68. di-n-butyl phthalate	39112	5000U		
39. fluoranthene	34379	5000U		
84. pyrene	34472	5000U		
67. butyl benzyl phthalate	34295	5000U		
5. benzidine	39121	10000U		
66. bis(2-ethylhexyl) phthalate	39102	5000U		
76. chrysene 5/	34323			
72. 1,2-benzanthracene 5/	34529	5000U		
28. 3,3'-dichlorobenzidine	34634	5000U		
69. di-n-octyl phthalate	34599	5000U		
74. 3,4-benzofluoranthene 6/	34233			
75. 11,12-benzofluoranthene 6/	34245	5000U		
73. 3,4-benzopyrene	34250	5000U		
83. indeno (1,2,3-cd) pyrene	34406	5000U		
82. 1,2,5,6-dibenzanthracene	34559	5000U		
79. 1,12-benzoperylene	34524	5000U		
24. 2-chlorophenol	34589	2100U		
57. 2-nitrophenol	34594	2100U		
65a. phenol (GC/MS)	34695	2100U		
34. 2,4-dimethylphenol	34609	2100U		
31. 2,4-dichlorophenol	34604	2100U		
21. 2,4,6-trichlorophenol	34624	2100U		
22. parachlorometa cresol	34455	2100U		
59. 2,4-dinitrophenol	34619	17000U		
60. 4,6-dinitro-o-cresol	34660	2100U		
64. pentachlorophenol	39061	2100U		
58. 4-nitrophenol	34649	4200U		

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
1/ - Tentative identification.
2/ - and/or azobenzene.
3/ - and/or diphenylamine.
4/ - Phenanthrene and/or anthracene.
5/ - Chrysene and/or 1,2-benzanth
6/ - 3,4-benzofluoranthene and/or 11,12-benzofluoranthene.

(OVER)

DATA REPORTING SHEET
EXTRACTABLE ORGANIC ANALYSIS

EPA, SAD, RGN. IV
Athens, GA 47

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPL'D. 2-

RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C 0107		
SOURCE & STATION	IH-7 Eff. ditch at Culvert at Field Rd. below pipe.		
DATE/TIME	10-20-80 @ 1426		
COMPOUND	Concentration ug/kg	Concentration ug/kg	Concentrat ug/kg
C_3 alkyl phenol (2 isomers) 1/	2100K		
methyl ester of pentadecanoic acid 1/	2100K		
isobenzo furandione 1/	2100K		
methyl ester of methyl pentadecanoic acid 1/	4800J		
methyl ester of methyl hexadecanoic acid 1/	2100K		
methyl ester of octadecenoic acid 1/	4900J		
hexadecanoic acid 1/	6700J		
THE CHROMATOGRAM INDICATES THE PRESENCE OF A PETROLEUM TYPE PRODUCT.			

No other organic compounds detected with an estimated minimum detection limit of 5000 ug

J – Estimated value.
K – Actual value is known to be less than value given.
L – Actual value is known to be greater than value given.
U – Material was analyzed for but not detected. The number is the Minimum Detection Limit.

1/ – Tentative identification.

SEDIMENT
DATA REPORTING SHEET
PURGEABLE ORGANIC ANALYSIS

EPA-SAD, ...
ATHENS, GA
4/80

PROJECT International Harvester Memphis, TN CHEMIST E. W. Loy, Jr. REC'D. 10-20-80 COMPLET'D. 12-19-80

BASED ON WET WEIGHT BASIS

SAD NO.		81C 0103	81C 0104	81C 0105
SOURCE & STATION		IH-2 Depositional area below dump.	IH-3 Below dump ditch western side.	IH-5 composite of 4 top.
DATE/TIME		10-20-80 @ 1045	10-20-80 @ 1100	10-20-80@1130-1
Compound		ug/kg	ug/kg	ug/kg
dichlorodifluoromethane 2/	34334	5U	5U	5U
methyl chloride 2/	34421	5U	5U	5U
methyl bromide 2/	34416	5U	5U	5U
vinyl chloride 2/	34495	5U	5U	5U
chloroethane 2/	34314	5U	5U	5U
methylene chloride 2/	34426	5U	5U	5U
trichlorofluoromethane 2/	34491	5U	5U	5U
1,1-dichloroethylene 2/	34504	5U	5U	5U
1,1-dichloroethane 2/	34499	5U	5U	5U
1,2-trans-dichloroethylene 2/	34549	5U	5U	5U
chloroform 2/	34318	5U	5U	5U
1,2-dichloroethane 2/	34534	5U	5U	5U
1,1,1-trichloroethane 2/	34509	5U	5U	5U
carbon tetrachloride 2/	34299	5U	5U	5U
dichlorobromomethane 2/	34330	5U	5U	5U
1,2-dichloropropane 2/	34544	5U	5U	5U
1,3-dichloropropylene 2/	34564	5U	5U	5U
trichloroethylene 2/	34487	5U	5U	5U
benzene 2/	34237	5U	5U	5U
chlorodibromomethane 2/	34309	5U	5U	5U
1,1,2-trichloroethane 2/	34514	5U	5U	5U
2-chloroethyl vinyl ether (mixed) 2/	34579	5U	5U	5U
bromoform 2/	34290	5U	5U	5U
1,1,2,2-tetrachloroethane 2/	34519	5U	5U	5U
tetrachloroethylene 2/	34478	5U	5U	5U
toluene 2/	34483	5U	5U	5U
chlorobenzene 2/	34304	5U	5U	5U
ethylbenzene 2/	34374	5U	5U	5U
acrolein 2/	34213	100U	100U	100U
acrylonitrile 2/	34218	100U	100U	100U
dihydrothiophene 1/		5U	5U	8J

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit.
NA - Not analyzed.
1/ - Tentative identification.
2/ - On NRDC List of Priority Pollutants.

SEDIMENT
DATA REPORTING SHEET
PURGEABLE ORGANIC ANALYSIS

ATHENS, GA
4/80

PROJECT International Harvester Memphis, TN CHEMIST E. W. Lov, Jr. REC'D. 10-20-80 COMPLET'D. 12-1

BASED ON WET WEIGHT BASIS

SAD NO.		81C 0106	81C 0107	
SOURCE & STATION		IH-4 Below dump northern part.	IH-7 Effluent ditch at Culvert.	
DATE/TIME		10-20-80 1120-1145	10-20-80 1125-1145	
Compound		ug/kg	ug/kg	ug/kg
dichlorodifluoromethane 2/	34334	5K	5[illegible]	
methyl chloride 2/	34421	5U	5[illegible]	
methyl bromide 2/	34416	5U	5U	
vinyl chloride 2/	34495	5U	5U	
chloroethane 2/	34314	5U	5U	
methylene chloride 2/	34426	5U	5U	
trichlorofluoromethane 2/	34491	5U	5U	
1,1-dichloroethylene 2/	34504	5U	5U	
1,1-dichloroethane 2/	34499	5U	5U	
1,2-trans-dichloroethylene 2/	34549	5U	5U	
chloroform 2/	34318	5U	5U	
1,2-dichloroethane 2/	34534	5U	5U	
1,1,1-trichloroethane 2/	34509	5U	5U	
carbon tetrachloride 2/	34299	5U	5U	
dichlorobromomethane 2/	34330	5U	5U	
1,2-dichloropropane 2/	34544	5U	5U	
1,3-dichloropropylene 2/	34564	5U	5U	
trichloroethylene 2/	34487	5U	5U	
benzene 2/	34237	5U	5U	
chlorodibromomethane 2/	34309	5U	5U	
1,1,2-trichloroethane 2/	34514	5U	5U	
2-chloroethyl vinyl ether (mixed) 2/	34579	5U	5U	
bromoform 2/	34290	5U	5U	
1,1,2,2-tetrachloroethane 2/	34519	5U	5U	
tetrachloroethylene 2/	34478	5U	5U	
toluene 2/	34483	5U	5U	
chlorobenzene 2/	34304	5U	5U	
ethylbenzene 2/	34374	5U	5U	
acrolein 2/	34213	100U	100U	
acrylonitrile 2/	34218	100U	100U	

J - Estimated value.
K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
U - Material was analyzed for but not detected. The number is the Minimum Detection Limit
NA - Not analyzed.
1/ - Tentative identification.
2/ - On NRDC List of Priority Pollutants.

DATA REPORTING SHEET
SEDIMENT

EPA-SAD-LSB-4-10-5

PROJECT International Harvester Memphis, TN   CHEMIST B. McDaniel   REC'D 10-20-80   COMPL'D 12-17-80

PROJECT NUMBER 81-6   RESULTS ON DRY WEIGHT BASIS

SAD NO.		81C 0103	81C 0104	81C 0105	81C 0106
SOURCE & STATION		IH-2 Deposition at area below SO most part of dump.	IH-3 Area below dump ditch on western side of site.	IH-5 Composite of 4 sites from top of dump.	IH-4 Area belo dump on northe most part of dump.
DATE/TIME		10-20-80 @ 1045	10-20-80 @ 1100	10-20-80@1130/114	10-20-80@1120-1
ELEMENT (mg/kg)					
Silver*	01078	2K	3K	3K	4K
Arsenic*	01003	9K	14K	14K	16K
Boron	01023				
Barium	01008	111	199	68	316
Beryllium*	01013	2K	3K	3K	4K
Cadmium*	01028	2K	3K	3K	4K
Cobalt	01038	4K	6K	6K	7K
Chromium*	01029	30	44	104	141
Copper*	01043	26	40	50	74
Molybdenum	01063	4K	6K	6K	7K
Nickel*	01068	18	31	29	35
Lead*	01052	70	112	57	468
Antimony*	01098	5K	8K	8K	9K
Selenium*	01148	8K	12K	12K	14K
Tin	01103	12K	18K	18K	21K
Strontium	01083	37	48	46	92
Tellurium	45513	8K	12K	12K	14K
Titanium	01153	275	533	112	320
Thallium*	34480	20K	30K	30K	35K
Vanadium	01088	19	49	17	27
Yttrium	45514	5	11	4	8
Zinc*	01093	83	147	54	175
Zirconium	01163	4	3K	3K	5
Mercury*	71921	0.05K	0.05K	0.05K	0.05K
Calcium	00917	17638	13170	6591	19300
Magnesium	00924	5176	7497	2977	6800

- CONTINUED ON BACK -

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

- CONTINUATION -
DATA REPORTING SHEET
SEDIMENT

PROJECT International Harvester Memphis, TN   CHEMIST B. McDaniel   REC'D 10-20-80   COMPL'D 12-17-80

PROJECT NUMBER ____________   RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C	0103	0104	0105	0106
SOURCE & STATION		IH-2 Deposition area below SO. most part of dump.	IH-3 Area below dump ditch on western side of site.	IH-5 Composite of 4-sites from top of dump.	IH-4 Area be. dump on Nortl most part of dump.
DATE/TIME		10-20-80 @ 1045	10-20-80 @ 1100	10-20-80@1130-1143	10-20-80@112(
ELEMENT (mg/kg)					
Aluminum	01108	7282	20985	6200	15900
Iron	01170	21360	30990	29680	41100
Manganese	01053	502	786	426	665
Sodium	00934	200K	300K	390	545
Cyanide*(Wet Weight)	00721				
Percent Moisture (%)		15	28	12	22
Asbestos *	34228	NA	NA	NA	NA

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

- CONTINUATION -
DATA REPORTING SHEET
SEDIMENT

EPA-SAD-LSB-4-10-8
8

PROJECT International Harvester
Memphis, TN

CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 12-17-80

PROJECT NUMBER 81-6

RESULTS ON DRY WEIGHT BASIS

SAD NO.					
SOURCE & STATION					
DATE/TIME					
ELEMENT (mg/kg)					
Aluminum	01108	23750			
Iron	01170	31050			
Manganese	01053	875			
Sodium	00934	400K			
Cyanide*(Wet Weight)	00721				
Percent Moisture (%)		33			
Asbestos *	34228	NA	NA	NA	NA

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

DATA REPORTING SHEET
SEDIMENT

EPA-SAD-LSB-4-10

PROJECT International Harvester Memphis, TN   CHEMIST B. McDaniel   REC'D 10-20-80   COMPL'D 12-17-

PROJECT NUMBER 81-6   RESULTS ON DRY WEIGHT BASIS

SAD NO.	81C	0107			
SOURCE & STATION		IH-7 Eff. ditch at Culvert at field Rd. below pipe.			
DATE/TIME		10-20-80@1425-1145			
ELEMENT (mg/kg)					
Silver*	01078	3K			
Arsenic*	01003	14K			
Boron	01023				
Barium	01008	221			
Beryllium*	01013	4K			
Cadmium*	01028	4			
Cobalt	01038	8K			
Chromium*	01029	278			
Copper*	01043	37			
Molybdenum	01063	8K			
Nickel*	01068	33			
Lead*	01052	210			
Antimony*	01098	10K			
Selenium*	01148	16K			
Tin	01103	24K			
Strontium	01083	41			
Tellurium	45513	16K			
Titanium	01153	224			
Thallium*	34480	40K			
Vanadium	01088	55			
Yttrium	45514	14			
Zinc*	01093	174			
Zirconium	01163	4K			
Mercury*	71921	0.1			
Calcium	00917	6050			
Magnesium	00924	5350			

- CONTINUED ON BACK -

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

EPA, SAD, LSB
9/22/80

WATER
DATA REPORTING SHEET

SAD NO. 81C 0108 CONTRACT LAB NO. D0212 CONTRACT LAB Mead Technology
PROJECT International Harvester SOURCE & STATION IH-6 Eff. Ditch at Culvert at
Memphis, TN Field Road below pipe.
DATE/TIME SAMPLED 10-20-80 @ 1420 SAMPLE RECEIVED 10-20-80 DATA RECEIVED 12-17-80

VOLATILE COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L	TENTATIVELY-IDENTIFIED COMPOUNDS	ug/L
2V	Acrolein	34210	100U	The chromatogram indicates the	
3V	Acrylonitrile	34215	100U	presence of a petroleum-type	
4V	Benzene	34030	10U	product.	
6V	Carbon Tetrachloride	32102	10U		
7V	Chlorobenzene	34301	10U		
10V	1,2-Dichloroethane	32103	10U		
11V	1,1,1-Trichloroethane	34506	10U		
13V	1,1-Dichloroethane	34496	10U		
14V	1,1,2-Trichloroethane	34511	10U		
15V	1,1,2,2-Tetrachloroethane	34516	10U		
16V	Chloroethane	34311	10U		
19V	2-Chloroethylvinyl Ether	34576	10U		
23V	Chloroform	32106	10U		
29V	1,1-Dichloroethylene	34501	10U		
30V	1,2-Trans-Dichloroethylene	34546	10U		
32V	1,2-Dichloropropane	34541	10U		
33V	1,3-Dichloropropylene	34551	10U		
38V	Ethylbenzene	34371	10U		
44V	Methylene Chloride	34423	10U		
45V	Methyl Chloride	34418	10U		
46V	Methyl Bromide	34413	10U		
47V	Bromoform	32104	10U		
48V	Dichlorobromomethane	32101	10U		
49V	Trichlorofluoromethane	34488	10U		
50V	Dichlorodifluoromethane	34668	10U		
51V	Chlorodibromomethane	34306	10U		
85V	Tetrachloroethylene	34475	10U		
86V	Toluene	34010	10U		
87V	Trichloroethylene	39180	10U		
88V	Vinyl Chloride	39175	10U		

PESTICIDES/PCB'S ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
89P	Aldrin	39330	0.10U
90P	Dieldrin	39380	0.10U
91P	Chlordane (Tech. Mixture & Metabolites)	39350	0.10U
92P	4,4'-DDT (p,p'-DDT)	39300	0.10U
93P	4,4'-DDE (p,p'-DDE)	39320	0.10U
94P	4,4'-DDD (p,p'-TDE)	39310	0.10U
95P	a-Endosulfan-Alpha	34361	0.10U
96P	b-Endosulfan-Beta	34356	0.10U
97P	Endosulfan Sulfate	34351	0.10U
98P	Endrin	39390	0.10U
99P	Endrin Aldehyde	34366	0.10U
100P	Heptachlor	39410	0.10U
101P	Heptachlor Epoxide	39420	0.10U
102P	a-BHC-Alpha	39337	0.10U
103P	b-BHC-Beta	39338	0.10U
104P	γ-BHC-(Lindane)-Gamma	39340	0.10U
105P	δ-BHC-Delta	34259	0.10U
106P	PCB-1242 (Aroclor 1242)	39496	0.10U
107P	PCB-1254 (Aroclor 1254)	39504	0.10U
108P	PCB-1221 (Aroclor 1221)	39488	0.10U
109P	PCB-1232 (Aroclor 1232)	39492	0.10U
110P	PCB-1248 (Aroclor 1248)	39500	0.10U
111P	PCB-1260 (Aroclor 1260)	39508	0.15U
112P	PCB-1016 (Aroclor 1016)	34671	0.10U
113P	Toxaphene	39400	0.40U
129P	2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	34675	NA

NA - Not analyzed.
J - Estimated value.
K - Actual value is known to be less than value given.

8/22/80

WATER
DATA REPORTING SHEET

SAD NO. 81C0108 CONTRACT LAB NO. D0212 CONTRACT LAB Mead Technology
PROJECT International Harvester SOURCE & STATION IH-6 EFF. Ditch at Culvert at
Memphis, TN Field Road below pipe.
DATE/TIME SAMPLED 10-20-80 @ 1420 SAMPLE RECEIVED 10-20-80 DATA RECEIVED 12-17-80

BASE/NEUTRAL COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
1B	Acenaphthene	34205	10U
5B	Benzidine	39120	10U
8B	1,2,4-Trichlorobenzene	34551	10U
9B	Hexachlorobenzene	39700	10U
12B	Hexachloroethane	34396	10U
17B	Bis(Chloromethyl) Ether	34268	NA
18B	Bis(2-Chloroethyl) Ether	34273	10U
20B	2-Chloronaphthalene	34581	10U
25B	1,2-Dichlorobenzene	34536	10U
26B	1,3-Dichlorobenzene	34566	10U
27B	1,4-Dichlorobenzene	34571	10U
28B	3,3'-Dichlorobenzidine	34631	10U
35B	2,4-Dinitrotoluene	34611	10U
36B	2,6-Dinitrotoluene	34626	10U
37B	1,2-Diphenylhydrazine 1/	34346	10U
39B	Fluoranthene	34376	10U
40B	4-Chlorophenyl Phenyl Ether	34641	10U
41B	4-Bromophenyl Phenyl Ether	34636	10U
42B	Bis(2-Chloroisopropyl) Ether	34283	10U
43B	Bis(2-Chloroethoxy) Methane	34278	10U
52B	Hexachlorobutadiene	39702	10U
53B	Hexachlorocyclopentadiene	34386	10U
54B	Isophorone	34408	10U
55B	Naphthalene	34696	10U
56B	Nitrobenzene	34447	10U
61B	N-Nitrosodimethylamine	34438	NA
62B	N-Nitrosodiphenylamine 2/	34433	10U
63B	N-Nitrosodi-N-Propylamine	34428	10U
66B	Bis(2-Ethylhexyl) Phthalate	39100	50U
67B	Butyl Benzyl Phthalate	34292	10U
68B	Di-N-Butylphthalate	39110	10U
69B	Di-N-Octylphthalate	34596	10U
70B	Diethylphthalate	34336	10U
71B	Dimethylphthalate	34341	10U
72B	Benzo (A) Anthracene 4/	34526	10U
73B	Benzo(A) Pyrene	34247	10U
74B	3,4-Benzofluoranthene 5/	34230	10U
75B	Benzo(K) Fluoranthene 5/	34242	10U
76B	Chrysene 4/	34320	10U
77B	Acenaphthylene	34200	10U
78B	Anthracene 3/	34220	10U
79B	Benzo(GHI) Perylene	34521	25U
80B	Fluorene	34381	10U
81B	Phenanthrene 3/	34461	10U
82B	Dibenzo(A, H) Anthracene	34556	25U
83B	Indeno (1,2,3-CD) Pyrene	34403	25U
84B	Pyrene	34469	25U

ACID COMPOUNDS ON NRDC LIST OF PRIORITY POLLUTANTS			ug/L
21A	2,4,6-Trichlorophenol	34621	25U
22A	P-Chloro-m-Cresol	34452	25U
24A	2-Chlorophenol	34586	25U
31A	2,4-Dichlorophenol	34601	25U
34A	2,4-Dimethylphenol	34606	25U
57A	2-Nitrophenol	34591	25U
58A	4-Nitrophenol	34646	25U
59A	2,4-Dinitrophenol	34616	250U
60A	4,6-Dinitro-o-Cresol	34657	250U
64A	Pentachlorophenol	39032	25U
65A	Phenol (GC/MS)	34694	25U

K - Actual value is known to be less than value given.
U - Material was analyzed for but not detected. The number is the minimum detection limit.
1/ - And/or Azobenzene.
2/ - And/or Diphenylamine.
3/ - 81B Phenanthrene and/or 78B Anthracene.

DATA REPORTING SHEET
WATER

EPA-SAD-LSB 4-10-80

PROJECT International Harvester Memphis, TN CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 11-20-80

PROJECT No. 81-6

SAD NO.	81- C	0103			
SOURCE & STATION		IH-6 EFF Ditch at Culvert and Field Rd. Below Pipe.			
DATE/TIME		10-20-80 @ 1420-1145			
ELEMENT (ug/L)					
Silver *	01077	10K			
Arsenic *	01002	45K			
Boron	01022	---			
Barium	01007	41			
Beryllium *	01012	10K			
Cadmium *	01027	10K			
Cobalt	01037	20K			
Chromium *	01034	104			
Copper *	01042	14			
Molybdenum	01062	215			
Nickel *	01067	35K			
Lead *	01051	40K			
Antimony *	01097	25K			
Selenium *	01147	40K			
Tin	01102	60K			
Strontium	01082	44			
Tellurium	01064	40K			
Titanium	01152	10K			
Thallium *	01059	100K			
Vanadium	01087	10K			
Yttrium	01203	10K			
Zinc *	01092	---			
Zirconium	01162	10K			
Mercury *	71900	0.2K			
Aluminum	01105	300			
Manganese	01055	50K			

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

(Continued on Back)

[illegible]

DATA REPORTING SHEET
WATER

PROJECT International Harvester CHEMIST B. McDaniel REC'D 10-20-80 COMPL'D 11-20
Memphis, TN
PROJECT No. 81-6

SAD NO. 81C	0108			
SOURCE & STATION	IH-6 EFF Ditch at Cluvert and Field Rd. below pipe.			
DATE/TIME	10-20-80 @ 1420-1145			
ELEMENT (mg/L)				
Calcium 00916	13			
Magnesium 00927	5.9			
Iron 74010	1.0			
Sodium 00929	17			
Cyanide * 00720				
Asbestos * 34225	NA	NA	NA	NA

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

DATA REPORTING SHEET
WATER

EPA-SAD-LSB 4-10-80

PROJECT International Harvester - Memphis, TN CHEMIST B. McDaniel REC'D 10-21-80 COMPL'D 11-20-80
PROJECT No. 81-6

SAD NO. 81C	0150			
SOURCE & STATION	IH-001 NPDES Outfall in ditch downstream.			
DATE/TIME	10-21-80 @ 0935			
ELEMENT (ug/L)				
Silver * 01077	10K			
Arsenic * 01002	45K			
Boron 01022	---			
Barium 01007	38			
Beryllium * 01012	10K			
Cadmium * 01027	10K			
Cobalt 01037	20K			
Chromium * 01034	58			
Copper * 01042	11			
Molybdenum 01062	68			
Nickel * 01067	35K			
Lead * 01051	40K			
Antimony * 01097	25K			
Selenium * 01147	40K			
Tin 01102	60K			
Strontium 01082	38			
Tellurium 01064	40K			
Titanium 01152	10K			
Thallium * 01059	100K			
Vanadium 01087	10K			
Yttrium 01203	10K			
Zinc * 01092	---			
Zirconium 01162	10K			
Mercury * 71900	0.2K			
Aluminum 01105	154			
Manganese 01055	50K			

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

(Continued on Back)

DATA REPORTING SHEET
WATER

PROJECT Memphis, TN CHEMIST B. McDaniel REC'D 10-21-80 COMPL'D 11-2[illegible]

PROJECT No. 81-6

SAD NO. 81C	0150			
SOURCE & STATION	IH-001 NPDES Outfall in ditch downstream.			
DATE/TIME	10-21-80 @ 0935			
ELEMENT (mg/L)				
Calcium 00916	13			
Magnesium 00927	6.0			
Iron 74010	0.6			
Sodium 00929	12			
Cyanide * 00720				
Asbestos * 34225	NA	NA	NA	NA

K - Actual value is known to be less than value given.
L - Actual value is known to be greater than value given.
* - Priority Pollutant.

US EPA REGION IV S&A DIVISION
LABORATORY SERVICES BRANCH
DATA REPORTING SHEET
81C0103 - 81C0108
PROJECT # 81-6 ***PROG ELEMENT # CSI

ERNATIONAL HARVESTER

MPHIS STATE: TN

SAMPLE RECEIVED DATE & 10/20/80 1530

COMPLETED: 12/12/8

STATION	DATE & TIME SAMPLED	SAMPLE TYPE	ANALYSES TO BE RUN HG UG/L	METSC	CN MG/L	TOC MG/L	PH PH	TEM DEG C
IH-6 EFF DITCH @ CULVERT @ FIELD RD BELOW PIPE	10/20/80- 1420- 10/20/80 1145	AMBWA			.002K	15.0	6.4	25.0

ATTACHMENT 2

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER: International Harvester
ADDRESS: Memphis, TN
CONTACT:

SAMPLING STATION NO. IH-001
SAMPLING LOCATION: NPDES outfall 001 in ditch downstream from sanitary; tests contact cooling & non-contact cooling

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☑ IND. ☐ INF. ☑ EFF. ☐ ______ ☑ 24 HR. COMP. AT 30 MIN. INTERVALS ☐ FLOW PRO.

SAMPLER ☑ EPA ☐ DISCHARGER ☐ MAN. ☑ AUTO. ☑ TYPE ISCO 1680 # 13022 (.30)

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ______ EQUIP ______

COMPUTED FROM ______

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.	0150	0150				BACTERIAL	0
DATE	10/20/80 10/21/80	10/21/80				BOD, COD, TOC	1
TIME	1000 1030	0935				CYANIDE	2
FLOW (mgd) [1]	1.44					METALS	3
TEMPERATURE °C		25°				N, P	4
pH		7.3				ORG, O&G, PEST	5
TOT. Cl2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE	←	See below					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME		10/21/80 1030				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs
[2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
B [illegible]	10/21/80	1030	1		

REMARKS AND SKETCHES

@1 - 1pt glass metals

(pH meter buffered @ 7.0 prior to use; checked on 4 and on 10)

PH Buffered

4 4.2
7 6.8
10 9.9

(1,440,000 gal / 24 hr period)

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis, TN
CONTACT Gene Cottrell

SAMPLING STATION NO. IH-2
SAMPLING LOCATION Depositional area below southern most part of dump

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT SAMPLE ☐ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP
COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [12]	
SAD NO.		0103				BACTERIAL	0
DATE		10/20/80				BOD, COD, TOC	1
TIME		1045				CYANIDE	2
FLOW ( ) [11]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, ORG, PEST	5
TOT. Cl2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		See below					9
SAMPLED BY (Sig)		BH CFH					A
SEALED BY (Sig)		BH					B
DATE AND TIME		10/20/80 1200				PRESERVED	P

[11] Use Avg. Flow for Composites and Inst. Flow for Grabs — [12] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO CART.	RECEIPT NO.
Bob Quinn	10/20/80	1530	2		

REMARKS AND SKETCHES

1-1qt glass - organics < ext R / vol R

1-1pt ~~glass~~ plastic - metals R — dup. metals sample collected for IH; ~~see separate field sheet~~

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis, TN
CONTACT

SAMPLING STATION NO. IH-3
SAMPLING LOCATION Depositional area below dump on ditch on western side of site

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ ___ HR. COMP. AT ___ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ___ EQUIP
COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0164				BACTERIAL	0
DATE	/	10/20/80				BOD, COD, TOC	1
TIME	/	1100				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, O&G, PEST	5
TOT. Cl_2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		Sediment					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME		10/20/80 1200				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs
[2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
[illegible]	10/20/80	1530	2		

REMARKS AND SKETCHES

1 – 1 pt glass – organics < ext. P / vol. P

1 – 1 pt plastic – metals P (metals dupl. collected for IH)

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS
Memphis TN
CONTACT Gene Cuttrell

SAMPLING STATION NO. IH-4
SAMPLING LOCATION Depositional area below dump on northernmost part of dump (South of NPDES ditch); sample area drains to NPDES ditch

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ ____ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ____
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP ____
COMPUTED FROM ____

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0106				BACTERIAL	0
DATE	/	10/20/80				BOD, COD, TOC	1
TIME	/	1120				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, O&G, PEST	5
TOT. Cl2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		Sediment					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME	/	10/20/80 1201				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs
[2] Circle or indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO CART.	RECEIPT NO.
Bob Queen	10/20/80	15 30	2		

REMARKS AND SKETCHES

1 - 1qt glass - organics < ext. R / VOF R
1 - 1pt plastic - metals R (dupl metals collected for IH)

U.S. ENVIRONMENTAL PROTECTION AGENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis TN
CONTACT Gene Cuthill

SAMPLING STATION NO. IH-3
SAMPLING LOCATION Composite of several (4) locations on site from top of dump

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ SEDIMENT ☐ ___ HR. COMP. AT ___ MIN. INTERVALS ☐ FLOW PRO.
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ___
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ___ EQUIP ___
COMPUTED FROM ___

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0102				BACTERIAL	0
DATE		10/20/80				BOD, COD, TOC	1
TIME		1130 - 1145				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, O&G, PEST	5
TOT. Cl2 RES. mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		Sediment					9
SAMPLED BY (Sig)		SBH Cuthill					A
SEALED BY (Sig)		SBH					B
DATE AND TIME		10/20/80 1200				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs — [2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO CONT.	NO CART.	RECEIPT NO.
Bob Quinn	10/20/80	13:30	2		

REMARKS AND SKETCHES

1- "lower pile" - 1130
2- "upper pile" - 1140
3- " " 1142
4- " " 1145
1- 1qt glass- organic (ext ℓ / VOA ℓ)
1- 1pt plastic - metals ℓ (dupl. metals collected for IH)

U.S. ENVIRONMENTAL PROTECTION D 0212
SURVEILLANCE AND ANALYSIS D

REGION IV — ATHENS, GEORGIA

DISCHARGER International Harvester
ADDRESS Memphis TN
CONTACT Gene Cuthrell

SAMPLING STATION NO. IH-6
SAMPLING LOCATION Effluent ditch @ culvert @ [illegible] road ≈ 100 ft below discharge (NPDES) pipe

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☐ WATER ☐ ____ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO
SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE
FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP
COMPUTED FROM

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE L2	
SAD NO.		0108				BACTERIAL	0
DATE		10/20/80				BOD, COD, TOC	1
TIME		1420				CYANIDE	2
FLOW ( ) L1						METALS	3
TEMPERATURE °C		25.0				N, P	4
pH		6.4				ORG, O&G, PEST	5
TOT. Cl2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		see below					9
SAMPLED BY (Sig)		[illegible]					A
SEALED BY (Sig)		[illegible]					B
DATE AND TIME		10/20/80 1530				PRESERVED	P

L1 Use Avg. Flow for Composites and Inst. Flow for Grabs   L2 Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
B. L. Bruun	10/20/80	1530	5		

REMARKS AND SKETCHES

D-0212

1 - 1 gal glass - organics
1 - 1 pt glass - metals — metals dupl. collected for I H
1 - VIAL - VOA
1 - ½ gal plastic - CN
1 - TOC

U.S. ENV. ONMENTAL PROTECTION ;ENCY
SURVEILLANCE AND ANALYSIS DIVISION

REGION IV — ATHENS, GEORGIA

DISCHARGER: International Harvester

ADDRESS: Memphis, TN

CONTACT: Gene Cuthell

SAMPLING STATION NO.: IH-7.

SAMPLING LOCATION: Effluent ditch @ culvert @ field road ≈ 1000 ft below NPDES discharge pipe

SAMPLE AND WASTE FLOW INFORMATION

SAMPLE ☐ MUN. ☐ IND. ☐ INF. ☐ EFF. ☒ SEDIMENT ☐ ____ HR. COMP. AT ____ MIN. INTERVALS ☐ FLOW PRO.

SAMPLER ☐ EPA ☐ DISCHARGER ☐ MAN. ☐ AUTO. ☐ TYPE ____

FLOW ☐ EPA ☐ DISCHARGER ☐ AVG. ☐ INST. ☐ EST. ☐ ____ EQUIP ____

COMPUTED FROM ____

SAMPLE COLLECTION

	COMPOSITE	GRAB SAMPLES				SAMPLE CODE [2]	
SAD NO.		0107				BACTERIAL	0
DATE		10/20/80				BOD, COD, TOC	1
TIME		1425				CYANIDE	2
FLOW ( ) [1]						METALS	3
TEMPERATURE °C						N, P	4
pH						ORG, O&G, PEST	5
TOT. Cl_2 RES, mg/l						PHENOLS	6
						SOLIDS	7
							8
SAMPLE CODE		See below					9
SAMPLED BY (Sig)		JSH, GA, TILL					A
SEALED BY (Sig)		GDL/CA					B
DATE AND TIME		10/20/80 1500				PRESERVED	P

[1] Use Avg. Flow for Composites and Inst. Flow for Grabs [2] Circle or Indicate Analysis and Enter Numerical Code

SAMPLE CUSTODY AND SHIPPING INFORMATION

SAMPLES RELEASED TO (SIG) OR SHIPPED VIA	DATE	TIME	NO. CONT.	NO. CART.	RECEIPT NO.
Bob Quinn	10/20/80	15:30	2		

REMARKS AND SKETCHES

1 – 1 qt glass – organics – ext. P VOA P

1 – pt plastic – metals P (dupl. metals collected for IH)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
ATHENS, GEORGIA 30613

DATE: MAY 05 1981

SUBJECT: Supplemental Report -- Hazardous Waste Site Investigation -- International Harvester Company -- Memphis, Tennessee

FROM: Director, Surveillance and Analysis Division

TO: Howard Zeller, Acting Director
Enforcement Division

Attached is a copy of the subject report. A copy of this report should be sent to:

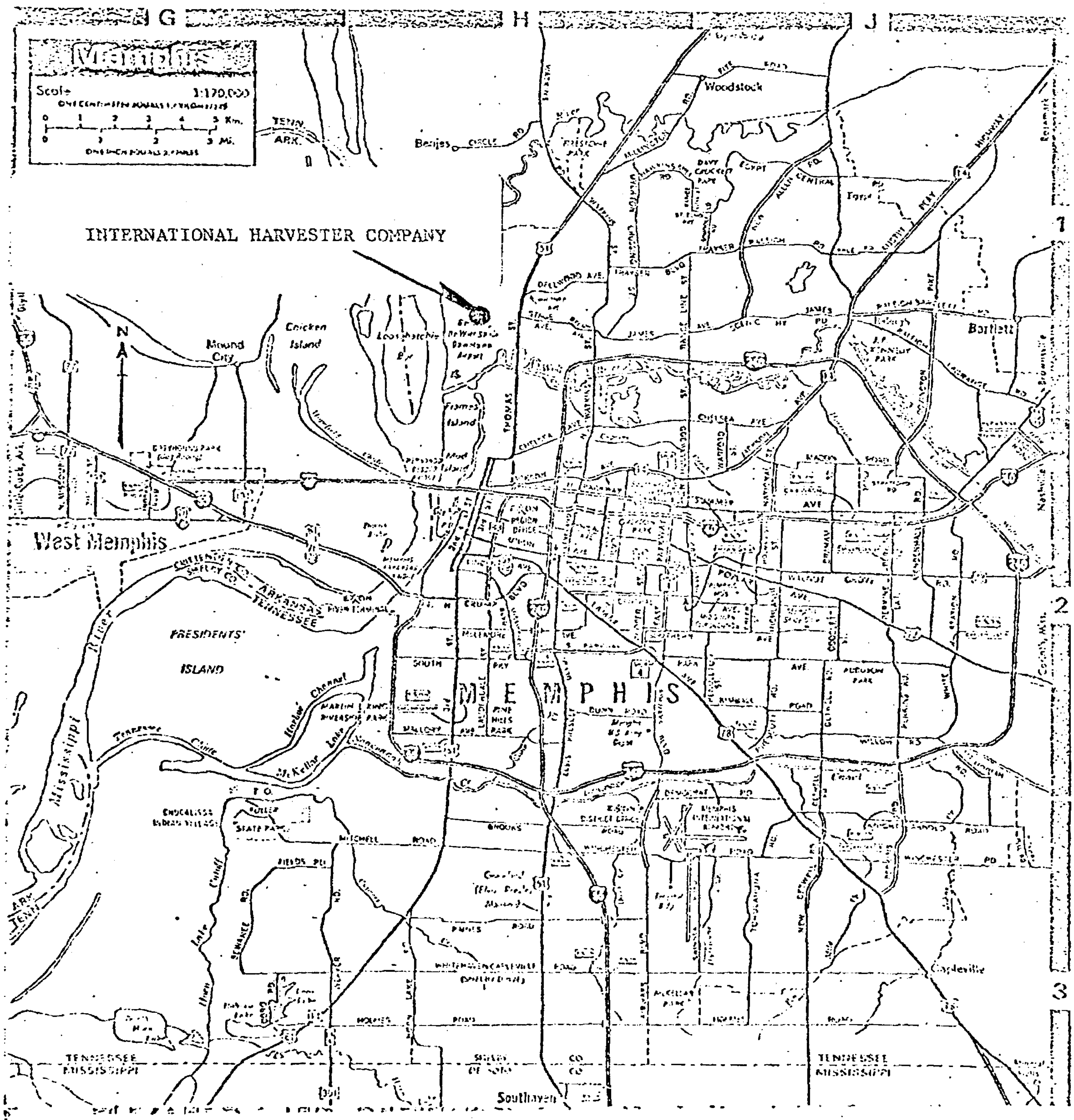
Mr. Gene Cutrell, Plant Engineer
International Harvester
3003 Harvester Lane
Memphis, Tennessee 38127

Billy H. Adams/for
James H. Finger

Attachment

cc: Wilburn
Scarbrough/Mathis
Newton/Turnipseed
Adams
Carroll/Bennett
Carter/Lair
Hall/Till

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE



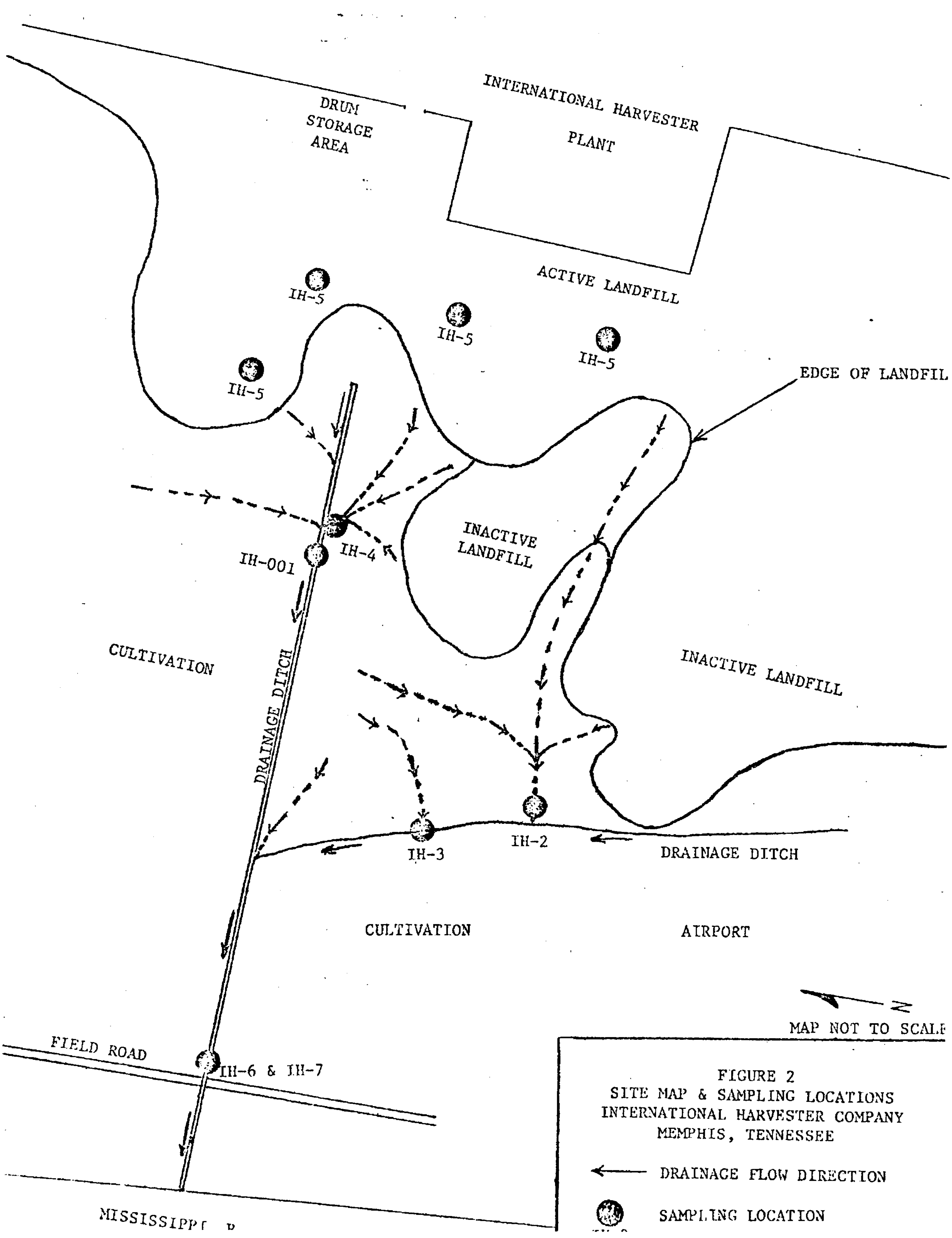


FIGURE 2
SITE MAP & SAMPLING LOCATIONS
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE

INTERNATIONAL HARVESTER
3003 HARVESTER AVENUE
MEMPHIS, TENNESSEE

I. Site Identification

A. Name - International Harvester
B. County - Shelby
C. Nearest Urban Area - Memphis
D. Water Supplies Potentially Affected

1. Public - Not affected
2. Private - Not affected
3. Other

a) Drainage ditches on site empty towards the Mississippi River

b) The landfill lies in the floodplains of the Mississippi River and is not protected from possible floodwaters.

c) The site also drains into fields that grow soybeans and wheat.

E. Acreage - 10 acres

II. Site History

A. Owner - International Harvester Corp.
B. Operator - International Harvester Corp., G. W. Beadles, Manager
C. Hazardous Waste Data

1. Source - International Harvester
2. Volume - approximately 1000-2000 tons
3. Types of Wastes - Wood, paper, foundry sand, glass, metal scraps, cardboard, trash, paint and paint sludge, washing machine sludge, oils, greases, coolants, wastewater treatment sludge, spent transformer oil, varnish, sealing compound, caustics and acids, electroplating treatment sludge and miscellaneous industrial solid waste

D. Period of Operation - 1947 to present

E. Current Status - Feasibility study for closure submitted to SWM Superfund.

III. Investigations

A. Sampling Data

On October 20-21, 1980, EPA conducted a hazardous waste site investigation. During this investigation five sediment or soil samples and two water samples were collected. Chromium and lead were below or slighly above drinking water limits in water, but were very high in sediment/soil; high levels of PCBs were found in all soil samples, and

moderate to low amounts of some extractable/purgeable organic compounds were also found in soil/sediment samples.

Although chromium and lead contamination may enter the Mississippi River, the flow of this river, 470,000 cu. ft/sec., is enough to dilute it. The metal, PCB and organic-contaminated soil may, however, be washed into adjacent fields, which grow food crops, and may also migrate in the event of flooding.

B. Other Investigating Work - None

C. Costs Incurred

Entity	Activity	Cost
EPA	Site Investigation	$15,000

IV. Enforcement Action

1. TN

September 1, 1981 - (SWM & EPA) International Harvester informed that their landfill was out of compliance with the floodplain criteria and was on the EPA open dump inventory.

September 17, 1981 - March 17, 1982 - Extension granted for submittal of a feasibility study for correcting the floodplain problem. Feasibility study submitted March 17, 1982. International Harvester accepted recommendation to close the landfills but subsequently developed financial problems. SWM allowed sufficient time for them to recover financially before requiring closure.

May 6, 1983 (SWM) - Hazardous Waste inspection found no violations for hazardous waste generators.

November, 1983 SWM Superfund staff reviewed closure plan and developed recommendations.

2. EPA

October 20, 1980 - Conducted a hazardous waste site inspection.

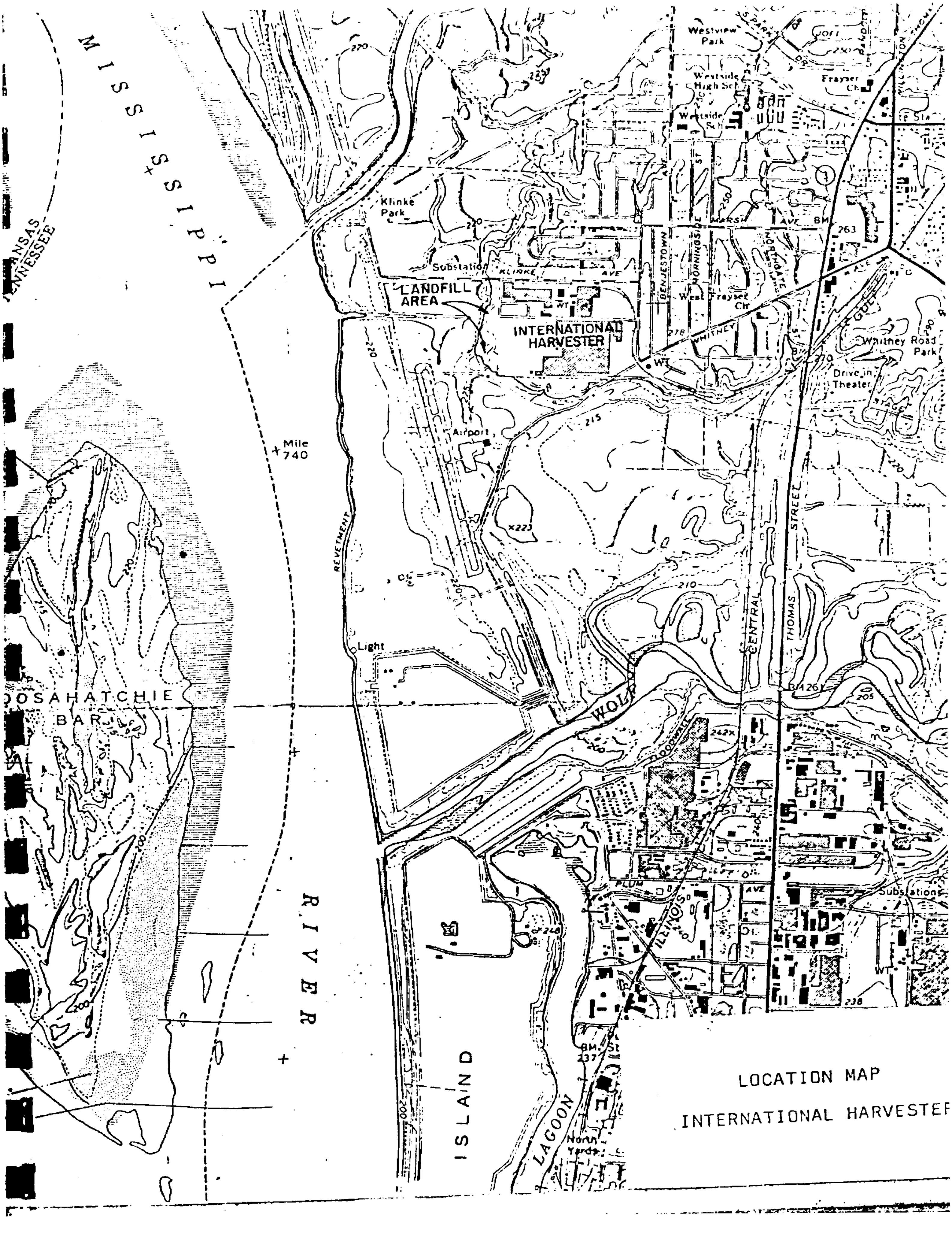
October 23, 1981 - International Harvester informed of potential violations of RCRA.

3. Local - None

V. Remedial Action

Entity	Activity	Cost

None to date



LOCATION MAP

INTERNATIONAL HARVESTER

FIGURE 1
GENERAL LOCATION MAP
INTERNATIONAL HARVESTER COMPANY
MEMPHIS, TENNESSEE